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ABSTRACTS OF PAPERS PRESENTED AT THE THIRTEENTH ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, TORONTO, CANADA, DECEMBER 28 TO 31, 1921.

Ophiobolus cariceti (Berk. & Br.) Sacc., cause of take-all of wheat. H. M. FITZPATRICK, H. E. THOMAS, AND R. S. KIRBY.

The discovery in Monroe County, New York, of perithecia of a species of Ophiobolus on wheat plants showing characteristic symptoms of the take-all disease was reported in Science in October, 1920. Subsequently additional collections of the fungus were made in scattered localities. It has been grown in pure culture and inoculations have demonstrated it to be the causal organism of the take-all disease. It has been compared with various foreign collections of material, and found to be identical with the species known as *O. graminis* in England, France, Japan, Italy, and Australia. Study of type and other authentic material of *O. cariceti* (Berk. & Br.) Sacc. from Kew shows this species to be identical with the take-all organism. Since this name antedates *O. graminis* Sacc. it is accepted for the species and *O. graminis* is regarded as a synonym. Berlese's assertion that *O. cariceti* is identical with *O. eucryptus* has been found to be incorrect. A paper embodying the results of the investigation and containing a detailed description and illustrations of the organism will appear in the next number of Mycologia.

The take-all disease of cereals and grasses. R. S. KIRBY.

Ophiobolus cariceti has been demonstrated to be the cause of the take-all disease previously reported as occurring in New York on wheat, rye, and *Agropyron repens*. The causal organism was isolated, grown in pure culture on numerous media, and typical perithecia were produced. The fungus is confined to the roots and the lower internodes of the host. Perithecia are produced in abundance, over one hundred having been found on single culms. The fungus is not disseminated in the seed, but lives for varying lengths of time in the soil and on the straw. The disease is more destructive on alkaline than on acid soils. Correlated with this the growth of the organism has been shown to be better on alkaline than on acid media. On corn meal agar growth begins at about 4.5 pH and increases gradually to 8.1 pH, the point at which maximum growth occurs. As the results of inoculations in the greenhouse typical perithecia were produced on wheat, barley, and rye, and on one or more species of the following genera of wild grasses: Agropyron, Bromus, Elymus, Festuca, Hordeum, Hystrix, Lolium, and Phalaris.

Foot-rot disease of wheat in Kansas. H. H. MCKINNEY AND L. E. MELCHERS.

This disease was first noticed in Kansas in 1920. In 1921 a survey showed the disease to be present in seventeen fields on eleven farms located in Dickinson, Saline, Riley, and

Cheyenne Counties. Both hard and soft wheats were affected. In some fields the disease caused almost a total crop loss.

The disease occurred in scattered, circular, or irregular spots, of various sizes. These occurred without regard to topography or soil conditions. The first indication of the disease was a yellowing of affected plants shortly after resumption of growth in the spring. This yellowing continued until plants approached maturity. Diseased plants became bleached and remained stiff and upright. A distinct black scale or plate of interwoven mycelium developed at the base of many of the diseased plants, between or underneath the leaf sheaths next to the culm. The disease resembles the true take-all disease occurring in this country and described in foreign literature, but differs in several respects from the so-called take-all disease occurring in Illinois and Indiana. The cause of the disease in Kansas remains unknown. (U. S. Bureau of Plant Industry and Kansas Agricultural Experiment Station cooperating.)

The Helminthosporium disease of wheat and the influence of soil temperature on seedling infection. H. H. MCKINNEY.

The Helminthosporium disease of wheat is now known to occur in the spring and winter wheat belts and in the western intermountain region. Under certain conditions the disease causes considerable crop loss. So far, practically all the strains of Helminthosporium isolated from wheat appear to be very similar if not identical. Comparisons with *Helminthosporium sativum* P. K. and B. isolated from spot blotch lesions on barley, show no marked morphological differences. Cross inoculations made with the wheat and barley strains of the organism on the foliage and the underground portions of the tillers of wheat and barley show that both strains produce the typical symptoms on both hosts. Field observations indicate that the disease is influenced by environmental conditions. Controlled soil-temperature experiments, conducted in the "Wisconsin temperature tanks," and field experiments show that seedling infection in both spring and winter wheat and in spring barley is greatest at relatively high temperatures. The optimum temperature apparently lies between 26° and 28° C. This is very near the optimum for the rate of growth of *H. sativum* in pure culture. (Office of Cereal Investigations, U. S. Department of Agriculture, and the Wisconsin Agricultural Experiment Station cooperating.)

A seedling blight caused by Fusarium culmorum var. leteius Sher. JESSIE P. ROSE.

In conducting germination tests with treated and untreated wheat of 18 varieties during the seasons of 1918–19 and 1920 at Corvallis, Oregon, the writer observed a high seedling mortality with which different fungi, particularly *Fusarium culmorum* var. *leteius*, were found associated. *Fusarium culmorum* var. *leteius* was found to penetrate the endosperm and young seedlings, and produced a typical seedling blight. Inoculation experiments with this fungus conducted in laboratory, greenhouse, and field, using both treated and untreated spring and winter wheats, showed from 3 to 98 per cent of seedling blight, depending upon the condition of the seed and the environmental factors. The severity of the blighting depended upon soil moisture and temperature conditions, upon the amount of injury received from thrashing, and seed treatment injury as correlating factors. *Fusarium culmorum* var. *leteius* was isolated consistently from diseased seedlings of wheat, oats, barley, and rye grass obtained from different parts of Oregon. (Cooperative investigations between the Oregon Agricultural Experiment Station and the U. S. Office of Cereal Investigations.)

Diplodia zeae as an ear and root parasite of corn. EDWARD E. CLAYTON.

Work in Ohio during the winter of 1920 and 1921 showed that the fungus *Diplodia zeae* was very prevalent in seed corn. Many ears that appeared healthy were found to be infected with this organism, and often these infected ears were partly dead. Seed from such infected ears was planted in crocks and the soil held at the temperatures of 15 to 18°, 21 to 24°, and 29 to 31° C. With the soil temperatures from 21 to 24° C., the roots of the young plants were severely rotted; with the soil temperature 29 to 31° C., the fungus was only slightly less active; but at 15 to 18° C., the plants were not affected by the root rot. These temperature tests were repeated in the fall of 1921, using corn inoculated with Diplodia in pure cultures. Similar results were secured in ear to row field tests, where seed from healthy ears was compared with seed infested with Diplodia. A poor stand of plants and a poor yield of corn resulted from the Diplodia infection. During the summer of 1921, ears of corn in the field were inoculated with Diplodia, the fungus having been isolated from rotting roots. The inoculations made August 31 resulted in complete rotting of the ears. Practically all of the kernels in these ears were dead. Inoculations made September 20 gave a high percentage of infested ears, which, however, in most cases showed no symptoms of ear rot. Very few of the kernels in these ears were dead. Regarding the occurrence of natural infestion, the following data has been secured:

Time of natural infection of ears in field, 1921.

Date Corn picked	*Percentage of ears infected with Diplodia*
August 31	5%
Sept. 20	9%
Oct. 10	18%
Oct. 31	19%

Diplodia of corn in Iowa. L. W. DURRELL.

Studies on *Diplodia zeae* in pure culture indicate that a high humidity is necessary for optimum growth. Further temperature relations as determined on pure cultures under controlled conditions indicate a very high optimum temperature for growth. The cardinal temperatures are, optimum 29 to 31° C., maximum 34 to 36° C., and minimum 10 to 12° C. No growth occurs above 36° C., nor below 10° C. The crest of the temperature curve varies little between 27 and 31° C., with the peak nearer 30° C. The cultural reactions of the fungus correlate well with the combination of high temperature and humidity prevaling in central Iowa the past season. The infection of corn by Diplodia is largely through the nodes. Spores drop between sheath and stalk and later attack the corn tissue. Not all nodes are thus affected. Often one node will be found infected, the next two clean, the third above infected, and so forth. No evidence has been found that the fungus migrates up the stalk, but many plantings tend to show that the infection entering the node often works both ways from that point. Shanks of the ear are frequently found heavily infected with Diplodia. Cultural studies indicate that these diseased shanks became infected from the node. The fungus sometimes migrates from the shank to the butt of the ear. In the large majority of cases this year infection began at the butt of the ear. Many ears during the period of high humidity actually stood in water, the flask-like sheaths retaining water sufficient in some cases to sprout the grain. Under such conditions if Diplodia were present the entire ear and husk became completely infected. No constant relation has been found between Diplodia infection and the broken shanks and stalks.

The relation of soil temperature to the development of the seedling blight of corn caused by Helminthosporium sp. W. G. STOVER.

A species of Helminthosporium, isolated from living corn plants, was found to cause a marked seedling blight of corn. All inoculations were made by immersing corn seeds in a spore suspension before planting. Mesocotyl, cotyledonary node, and seminal roots were rotted. The diseased region was dark brown to deep black and usually shrunken. The optimum temperature range for the growth of the fungus on potato dextrose agar was 21 to 29° C., with the maximum growth at approximately 26° C. Inoculated and uninoculated corn was grown in the temperature tanks at the University of Wisconsin at temperatures of 8 to 36° C., with 4° intervals. The optimum soil temperature for growth of corn roots was apparently 20 to 24° C., and for growth of tops, 24 to 28° C. Seedling blight developed to some extent at all temperatures tried, but was much more marked from 16 to 24°, and especially at 20° C., where 100 per cent of the plants in several trials were attacked, and the ratio of severely diseased to slightly diseased seedlings was 9 to 1. Results of one trial indicated that a relatively high moisture content of the soil is favorable for the development of the disease.

Treatment of seed to control root and stalk rots. B. B. BRANSTETTER.

An experiment carried on at the Missouri Agricultural Experiment Station with seed corn infected with root and stalk rot organisms gave results indicating that seed treatment is effective in reducing the amount of root and stalk rot in the field. Corn gathered from various sources was germinated in a table germinator and classified as heavily infected, moderately infected, and slightly infected seed according to whether the seed showed a high, moderate, or slight per cent respectively of seedlings affected with root rots. Six rows 400 feet long with hills 3 feet apart were planted to each of these three groups of seed, but the seed in three rows of each group were first disinfected by immersing the seed momentarily in alcohol and then in mercuric chloride solution, 1: 1000, for one hour. In September while the healthy stalks were still green, these plants were inspected for root and stalk rots. Rows planted from heavily, moderately, and lightly infected seed averaged respectively 27.4, 16.4 per cent of diseased plants while seed from the same lots disinfected averaged respectively 15.5, 12.5, and 8.9 per cent of diseased plants. This indicates first, that the relative amount of disease in the field is roughly proportional to the root rot shown on the table germinator; and second, that disinfection of the seed as above described materially reduces the amount of root and stalk rot in the field.

The improved rag-doll germinator box. R. S. KIRBY.

A germinator box was devised which would make possible the separation with certainty of healthy seed corn from Fusarium-infected ears. The germinator consisted of a large box with double walls. The air inside this box was kept at complete humidity and constant temperature by a tank of water heated by electric elements controlled by a thermostat. The tank contained seven inches of water and rested on the bottom of the box. A wire screen was supported seven inches above the surface of the water. The space above the screen was divided into compartments, which were again subdivided by wires into spaces in each of which a rag doll would stand upright. Three inches above the dolls was a cover for each compartment. These in turn were covered with the lid of the box. The box was 70 x 38 x 38 inches and had a capacity of 6000 ears. Running the germinator at a temperature of 85° F., 12,500 ears of corn were tested in the spring of 1921 and graded according to the presence of Fusarium. By the use of

this box it was possible to obtain a grade of corn which had no Fusarium-infected kernels, as shown by a subsequent test on media.

The effect of fertilizers on the development of stem rust of wheat. E. C. STAKMAN AND OLAF S. AAMODT.

Since 1913 experiments have been made to determine the effect of artificial and natural fertilizers on amount of rust developed on susceptible and resistant varieties of wheat when grown on several soil types in different parts of Minnesota, under heavy artificially-induced epidemics, and under natural field conditions. The experiments were supplemented by controlled greenhouse experiments. The amount of rust was not changed directly by any fertilizer or combination of fertilizers, although date of maturity, degree of lodging, crinkling, shrivelling of seed, percentage of yellow-berry, and yield were affected profoundly. Leaf rust developed most abundantly on plats fertilized with nitrogen. On properly fertilized soil wheat yielded well regardless of heavy stem-rust attacks. In one plat fertilized with 250 pounds acid phosphate and 500 pounds potassium sulfate, Haynes Bluestem (Minn. 169) yielded 31 bushels per acre even though the rust infection was 88 per cent. Plants in plats fertilized with 1000 pounds sodium nitrate had 80 per cent of rust, but the acre yield was only 8 bushels. Neither potassium nor acid phosphate counteracted the effect of nitrogen in lowering yield on some types of soil. The effect of fertilizers on general character of plant growth and yield varied on different soil types, but the soil type, with or without fertilization, did not directly influence the amount of stem rust. (Cooperative investigations by the Minnesota Agricultural Experiment Station and the Office of Cereal Investigations, U. S. Department of Agriculture.)

The effect of rust infection upon the water-requirement of wheat. FREEMAN WEISS.

Wheat was grown to maturity in quartz sand cultures which were supplied with various combinations of mineral nutrients added in solution. An artificial epiphytotic of leaf rust, *Puccinia triticina*, was induced in one series of stem rust, *P. graminis tritici* in a second; while a third was maintained free from infection. Rust infection of either type resulted in lowered water economy of the plant, whether the dry matter of tops or heads is considered. The actual quantity of water transpired possessed significance in relation to infection only when the correlative production of dry matter was taken into account.

The addition of NaCl or NaH_2PO_4 to the basic 3-salt nutrient solution failed to modify the susceptibility of the host. $NaNO_3$ resulted in readier infection, but did not predispose the host to greater injury. KCl retarded infection, but when used in unbalanced proportions also markedly diminished yield of grain. $CaCl_2$ and $MgCl_2$ resulted in less ready and less severe infection. The former brought about greater water economy—about 10 per cent for tops and 40 per cent for grain. The Shive solution R3C3 as here used did not suffice for best development of wheat to maturity. The addition of .0085 and .0171 gram-molecules of $NaNO_3$ per liter of solution resulted in a 10 per cent increase in weight of tops, and .0171 gram-molecules of $CaCl_2$ increased both tops and grain, the latter by 60 per cent.

Inheritance of resistance to black stem rust in crosses between varieties of common wheat (Triticum vulgare). LEO E. MELCHERS AND JOHN H. PARKER.

Crosses were made in 1917, using three rust-resistant varieties of winter wheat, Kanred, P1066, and P1068; and three susceptible spring wheat varieties, Marquis,

Preston and Haynes Bluestem. The F_1 plants proved to be resistant when inoculated with a strain of *Puccinia graminis tritici*, to which Kanred is resistant. All inoculations were made in the greenhouse at time of heading. In the F_2 generation, 1921 plants were grown in the greenhouse and each plant was inoculated with stem rust. Definite segregation occurred. There were 1,375 plants which were classified as resistant and 546 described as susceptible. Both resistant and susceptible F_2 plants were tested. An F_3 generation of approximately 1,750 plants of the Kanred x Marquis cross was grown. The twenty F_2 susceptible plants of this cross gave only susceptible offspring in F_3, while of the 57 resistant F2 plants studied, 16 proved to be homozygous and 41 heterozygous. The progeny of the 41 heterozygotes included 1,117 plants, of which 822 were classified as resistant and 295 as susceptible. These results indicate that in the varieties used, rust resistance is determined by a single factor difference and that resistance is dominant and susceptibility recessive. In these crosses the character of resistance to the strain of stem rust used, seems to be inherited independently of other observed characters. (Cooperative investigations by Kansas Agricultural Experiment Station and Office of Cereal Investigations, U. S. Department of Agriculture.)

The inheritance of resistance to several biologic forms of Puccinia graminis tritici in a cross between Kanred and Marquis wheats. OLAF S. AAMODT.

A study was made of the inheritance of resistance to several biologic forms of *Puccinia graminis tritici* in a cross between two varieties of *Triticum vulgare*. Kanred, a winter wheat, which is immune from several biologic forms to which Marquis, the spring wheat parent, is susceptible. Observations were made at University Farm, St. Paul, Minnesota, in a field in which a heavy epidemic had been induced by spraying frequently with a water suspension of urediniospores of several biologic forms. As both parents were susceptible to some of these forms, all of the F_2 plants were heavily rusted in the field. F_3 seedlings were then inoculated in the greenhouse with one of the biologic forms from which Kanred is immune and to which Marquis is susceptible. The plants were either immune or completely susceptible. There were no intermediates. Immunity was dominant. Inoculation experiments indicate that apparently a single factor determines the reaction to several biologic forms. Families homozygous for spring character and rust resistance were obtained in the F_3 generation. (Cooperative investigations by the Minnesota Agricultural Experiment Station and the Office of Cereal Investigations, U. S. Department of Agriculture.)

Correlated inheritance in wheat of winter-spring habit of growth and rust resistance. OLAF S. AAMODT.

This study is one of the steps toward the production of a rust-resistant spring wheat. The parental varieties, Kanred and Marquis, belong to *Triticum vulgare*. Kanred, a winter wheat, is resistant to several biologic forms of *Puccinia graminis tritici* (Ericks. & Henn.) to which Marquis, a spring wheat, is susceptible. At University Farm, St. Paul, Minnesota, the Kanred when sown in the spring produces late in the season only an occasional head which fails to set seed. The F_2 Kanred-Marquis cross was sown in the spring and the plants were placed in nine groups, according to time of heading. Seven of these groups set seed and were tested in F_3. All individuals of the earlier-heading F_2 group bred true for spring habit of growth. In the six other groups in F_3 the percentage of spring plants was in direct relation to the time heading of the F_2 group. F_3 seedlings of each F_2 group were inoculated in the greenhouse with a single known biologic form of rust. The segregation approximated a ratio of 3 resistant to one sus-

ceptible plant. The ratio of resistant to susceptible plants was approximately the same for all heading periods. Preliminary tests indicate that the reaction to several biologic forms was inherited as a single genetic factor. (Cooperative investigations between the Office of Cereal Investigations, U. S. Department of Agriculture, and the Department of Agriculture of the University of Minnesota.)

Progress of the barberry eradication campaign. F. E. KEMPTON.

The cooperative campaign for barberry eradication, conducted in Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming, by the United States Office of Cereal Investigations has advanced through its fourth field season. During 1918 an organization was formed, a wide-spread campaign of publicity and education conducted, and surveys to locate bushes were begun. In 1919 the city and village surveys were almost completed and a systematic farm-to-farm survey completed in about 90 counties. In 1920 a resurvey of cities and villages was conducted and the farm-to-farm survey completed in 88 more counties. In 1921 the farm-to-farm survey, with resurvey of included cities and villages, was completed in 142 counties. Of these, 23 counties were surveyed on funds furnished by the State of Minnesota. Investigations were begun on chemical methods of eradicating both mature bushes and seedlings. From April 1, 1918, to October 31, 1921, all states in the eradication area provided themselves with laws compelling barberry eradication; almost all cities, towns, and villages therein were surveyed; and an area of approximately 321 counties was covered in the farm-to-farm survey, with necessary resurveys in a portion of these counties. The original survey is completed in Montana, Colorado, and Wyoming. A total of 5,601,257 bushes was located on 49,715 properties. Of these 4,418,738 bushes were removed from 45,036 properties. Of the 1,182,519 bushes remaining on 4, 679 properties, about 1,000,000 are escaped bushes, most of which are under 18 inches in height on 3 large escaped areas in Wisconsin.

Rye resistant to leaf rust, Puccinia dispersa. E. B. MAINS AND C. E. LEIGHTY.

Seed from a volunteer plant of rye in 1920 produced plants showing different degrees of susceptibility to the leaf rust of rye when tested in the greenhouse. Heads from four of these plants, two showing a high degree of resistance and two showing a high degree of susceptibility, were bagged in pairs in various combinations, and from the seed thus obtained plants have been grown which when inoculated with *P. dispersa*, show degrees of susceptibility from practically complete immunity to a very high degree of susceptibility. (Cooperative investigations by the Purdue University Agricultural Experiment Station and the Office of Cereal Investigations, U. S. Department of Agriculture.)

Infection capabilities of crown rust of oats. G. R. HOERNER.

Greenhouse inoculations of seedlings of grasses and varieties of cultivated oats were made with inoculum from four specimens of crown rust on oats collected at Lynchburg, Virginia, St. Paul, Minnesota, San Diego, California, and Tallulah, Louisiana. A summary of the work showed that there seemed to be slight differences in infection capabilities between the four specimens of the rust used in the experiments, though from the evidence at hand, no conclusions were drawn that there were a number of common hosts for *Puccinia coronata* Cda. and *P. graminis avenae* Eriks. and Henn., namely, a varying number of species of the following genera: Alopecurus, Anthoxanthum, Arrhenatherum, Avena, Bromus, Dactylis, Elymus, Festuca, Holcus, Hordeum, Lolium and Phleum; that under greenhouse conditions the crown rust of oats was capable of in-

fecting a varying number of species of the following genera: Agropyron, Alopecurus, Anthoxanthum, Arrhenatherum, Avena, Bromus, Dactylis, Elymus, Festuca, Holcus, Hordeum, Hystrix, Lolium, and Phleum. The work here reported was carried on while a graduate student at the University of Minnesota, 1916–1918. A detailed paper is in the source of preparation.

"Black point" of wheat. NEVADA S. EVANS.

Observations during the past year have shown that comparatively high percentage of the kernels of durum wheats of the Upper Mississippi Valley are often partly or entirely discolored, especially at the embryo end. These areas are dark brown or creosote colored. Hundreds of isolations made from typically discolored kernels have given, in the majority of cases, a species of Helminthosporium similar to *Helminthosporium sativum* P. K. & B. For example, in one series of black pointed seeds (260 kernels of D 5 and Acme) 77.6 per cent of the kernels yielded this fungus, while platings from several series of apparently healthy, plump seed from the same samples gave none of this organism. Likewise, the bran layer from discolored areas when plated gave from 85 to 100 per cent Helminthosporium. Discolored seeds when placed in moist chambers gave uniformly a surface sporulation of this same organism. In July, 1921, a number of isolations were made in the field at Madison, Wisconsin. Water suspensions of conidia of the fungus were applied to the heads of Acme and D5 wheat when in flower. Heads thus inoculated were covered with glassine bags for one and two days. In the cases where the inoculations were made when the conditions for infection were most favorable, abundant "black-pointed" kernels resulted in contrast to a low precentage in the controls where only water was applied.

The sesame spot disease of rice. G. O. OCFEMIA.

The sesame-spot disease of rice caused by *Helminthosporium oryzae*, previously reported from Japan, Java, Italy, and the Philippine Islands, was observed by Dr. W. H. Tisdale in Louisiana in 1920. An undetermined species of Helminthosporium also has been reported on rice in the Straits and Federated Malay States and in southern China. In Japan the disease was noted as important in 1896, caused serious damage in 1899, and later threatened the rice culture in some sections. Now it is well established in Japan and causes considerable damage when it develops in nursery beds. In Italy in 1906, Farneti concluded that *Helminthosporium oryzae* and *Piricularia oryzae*, said to be the most destructive of the rice fungi, are identical. In the Philippines in May 1918, the writer noted important seedling killing by *H. oryzae;* from 10 to 58 per cent of the seedlings of susceptible varieties were killed. The disease is most destructive on the rice seedlings, causing typical seedling blight. The leaves are also attacked, resulting in leaf blight. In 1900 Breda de Haan described the causal fungus in Java as *Helminthosporium oryzae*. A year later Miyabe and Hori in Japan independently gave the fungus the same name. The fungus is seed-borne as dormant mycelium, and infection of the seedlings results when infected kernels germinate. Subsequent sporulation results and secondary infection takes place any time during the rice growing season. There are apparently some morphological variations between the strains of Helminthosporium from various sources and these are being studied further. In Japan hot-water seed treatment practically prevents the disease. The Japanese also mention beneficial results from spraying. In Japan and in the Philippines certain varieties of rice are more resistant to the disease than others.

A new leaf spot of Kentucky Blue Grass caused by an undescribed species of Helminthosporium. CHARLES DRECHSLER.

A disease due to an undescribed species of Helminthosporium has been found affecting *Poa pratensis* L., in Wisconsin, Illinois, New York, Connecticut, Massachusetts, Maine, Maryland, and Virginia. It is manifested by the presence on the leaf blade of bluish black spots, usually relatively few in number and not exceeding 2 or 3 mm. in length, but occasionally becoming more abundant and considerably larger. The affected leaves wither and die prematurely, the withering beginning at the tip and proceeding toward the base. Not infrequently, especially in moist locations, the sheaths at the base of the plants are also affected, the discoloration being here, however, less intense and more generally diffused, giving rise to a condition not unlike the foot rot of wheat. The parasite is somewhat similar to *Helminthosporium sativum* P. K. and B. in producing thick-walled, dark, olivaceous spores, but differs from the latter species in the somewhat greater dimensions of the sporophores, in the spores germinating by the proliferation of germ tubes from intermediate as well as terminal segments, and in its relatively slow growth and meagre sporulation on artificial media. (Cooperative investigations by the Wisconsin Agricultural Experiment Station and the Office of Cereal Investigations, U. S. Department of Agriculture.)

Net blotch of meadow fescue caused by an undescribed species of Helminthosporium. CHARLES DRECHSLER.

A disease that has not hitherto been mentioned in the literature, and different from the spot-blotch reported from Iowa by Pammel, King, and Bakke, has been found affecting *Festuca elatior* at stations in Maine, Massachusetts, Connecticut, New York, Maryland, and the District of Columbia. The symptoms are very similar to those induced by *Helminthosporium teres* on barley. The newly affected green tissues show abundant brownish discoloration in irregular pattern, within which may be recognized a network of darker longitudinal and transverse linear streaks. After a considerable portion of the leaf blade has been involved, it gradually withers and dies, the withering beginning at the tip and proceeding toward the base. As the destruction of foliage continues throughout most of the season, the disease is easily the most serious parasitic trouble affecting meadow fescue in the Middle Atlantic States. The fungus responsible for the malady is a species of Helminthosporium, the spores of which are subhyaline to yellowish, straight, usually tapering markedly toward the apex, 1 to 7 septate, somewhat similar to those of *H. gramineum* Rabh., from which they differ, however, in shape and in mode of germination. (Office of Cereal Investigations, U. S. Department of Agriculture.)

Experiments with Haskell's method or the so-called dry formaldehyde treatment for the prevention of oat smut. J. E. HOWITT AND R. E. STONE.

This method has been tested by the writer for four successive years. In all, thirty-five field trials under ordinary farm conditions have been made and 2,122 bushels of oats treated. The varieties of oats treated included O. A. C. 72, Alaska, Banner, White Cluster, Mammoth Cluster, and Siberian. In 1918, 61 bushels of oats were treated; percentage of smut which developed in crop from treated seed 0, percentage of smut which developed in crop from untreated seed 6.5. In 1919, number of bushels of oats treated 630, percentage of smut in crop from treated seed 0, percentage of smut in crop from untreated seed 2.26. In 1920, number of bushels of oats treated 1,016; percentage of smut in crop from treated seed 0, percentage of smut in crop from un-

treated seed 2.36. In 1921, number of bushels of oats treated 415; percentage of smut in crop from treated seed 0, percentage of smut in crop from untreated seed 5.8. The average for the four years shows no smut in crop from treated seed and 4.23 per cent of smut in crop from untreated seed. Tests were made also to determine whether this treatment injured the vitality of the seed. In the four years experiments the average percentage of germination of treated and untreated seed was found to be exactly the same, namely 97.5 per cent. It is thus seen that the results have been uniformly satisfactory throughout the four years experiments. No injury to the vitality of the seed has resulted and the control of the smut has been almost perfect. In no case has there been more than a trace of smut in any of the fields sown with treated seed, while the amount of smut in the fields sown with untreated seed for check averaged 4.23 per cent. In some of the checks there was over 15 per cent of smut present. The advantages of this method over those which have been in general use heretofore are simplicity, rapidity and ease of application. In these experiments it was found that one hundred bushels of oats could be treated in fifty minutes by this method and that there was no waiting for the seed to dry after treatment, or danger of the grain sprouting or moulding or being swollen so that it would not run freely through the drill.

Results of treating seed of spring wheat and oats with copper carbonate dust to prevent smut. E. B. LAMBERT AND D. L. BAILEY.

In the spring of 1921 smutty seed of Prelude wheat and of Victory oats was treated with copper-carbonate dust (copper equivalent 20 per cent). The use of two ounces per bushel controlled the smut of oats completely and the use of as much as four ounces per bushel did not reduce the percentage of germination. Treatment of wheat with two ounces per bushel controlled bunt entirely, but in preliminary laboratory tests germination was reduced 8 to 16 per cent in different seed lots. However, the plots which were planted with this seed yielded more than did the checks. Subsequent tests demonstrated that treatment of wheat with two to ten ounces of the copper-carbonate dust per bushel did not reduce the viability of the seed when planted in soil in the greenhouse. Many tests were made on spring wheat with concentrated formaldehyde and while the seed often was not injured, germination of some seed lots was reduced as much as 60 per cent. The amount of injury increased when the wheat was not planted immediately after treatment. The percentage of injury from the standard sprinkle treatment with formaldehyde ranged from 0 to 42. Both formaldehyde treatments were safe and effective for oats. The table shows the percentage of smut and the percentage of seed germination in the experiments made in 1921.

	WHEAT		OATS	
Treatment	Per cent decrease in germination	Per cent * bunt	Per cent decrease in germination	Per cent smut
Check		18.5		13
Concentrated Formaldehyde (50–50)	33–62	2.1	0	3.0
Standard sprinkle (1–320)	21–42	1.4	0	0.2
Copper-carbonate dust (2–4 oz.)	See text	0	0	0

* Average of several tests.

Potato tipburn in northeastern Maine. DONALD FOLSOM AND E. S. SCHULTZ.

Tipburn was observed in Aroostook County during the last three summers, two of

of which were hot and dry, somewhat like mid-western summers. *Empoasca mali* was scarce, only one specimen being found in 1921 by the resident Maine Station entomologist. The hopperburn type was not seen. The sunscald type usually appeared within two to three hours of wind and bright sunlight, following several days of cloudiness and rain. The hot and dry weather type, aggravated by early blight and flea beetles and possibly other conditions which reduced the general vigor of the plant, appeared on check plots and commercial fields that had no copper spray applied, with late blight absent because of weather conditions. Furthermore, this type was severe in fields and plots sprayed well with Bordeaux mixture, and on plots, rows, hill lots, tuber units, and hills that were affected with leaf-roll, mosaic, and related diseases. This was true for certain of such hills planted and grown under cages containing no insects. This type of tipburn sometimes spreads throughout a hill in association with other signs of certain degeneration diseases. Nearby healthy controls were free from tipburn or nearly so. It seems possible that hopperburn, especially the systemic type reported from the Middle West, may sometimes be involved with mosaic and other degeneration diseases, of which the typical symptoms are modified by the climatic conditions that favor leaf hoppers.

Leaf hopper injury of potatoes. J. G. LEACH.

During the summer of 1921 a hitherto undescribed pathological condition of the potato plant was observed in Minnesota. Affected plants were characterized by a pronounced shortening of the leaf petioles, with the consequent crowding of the leaflets. The petioles and midveins of the leaflets also were much shorter than normal and the tips curved sharply downward and backward towards the petiole. At the same time, the margins of the leaflets were folded upward along the mid-vein. The potato leaf hopper (*Empoasca mali*) was very abundant and was constantly associated with the disease. By placing a number of the insects collected from affected plants on normal, healthy plants grown under cages, it was proved experimentally that the leaf hoppers were responsible for the disease. All plants so treated developed typical symptoms within seven days, while all check plants remained normal. Sufficient data have not been obtained to justify conclusions as to the nature of the disease and its relation to hopperburn caused by the same insect. The condition was very prevalent in Minnesota in 1921 and was undoubtedly responsible for considerable reduction in yield.

"Skin spot": a stage of powdery scab. MICHAEL SHAPOVALOV.

The "skin-spot" disease of Irish potato tubers has been reported from England and Canada, and as "pustulefaule" from Germany. Its peculiar characteristics are identical with those of the immature or closed-sorus stage of powdery scab. The spots have the same external appearance and the dead tissues a typical chocolate-brown or olive-brown color. Sections show a characteristic tapering spread of the infection between the cells. Fungus hyphae are sometimes very few and sometimes entirely absent. Various authors have attributed this disease either to different hyphomycetous fungi or to non-parasitic causes. This variance of opinion is due to the fact that the conclusions were based principally on cultural work. The writer's isolations from material obtained from various countries show that the fungi invading the "skin-spot" pustules vary with the locality. The progeny of some Spongospora-infected English potatoes planted in Pennsylvania developed "skin spot" in the absence of *Oospora pustulans*. Owen believed that in one case positive results were obtained from artificial inoculations of healthy tubers with *O. pustulans*, but the conditions of the experi-

ment do not warrant this conclusion. Hyphomycetes infesting the "skin-spot" pustules should be regarded as secondary invaders.

Progress notes on potato wart disease investigations. FREEMAN WEISS AND C. R. ORTON.

The season of 1921 was unfavorable for growth of potatoes in many parts of Pennsylvania, owing to deficient precipitation and high temperatures, particularly in June. Influence of untoward climatic conditions upon infection by *Synchytrium endobioticum* was exerted both directly upon the pathogen and indirectly through effect on the host which made a less succulent and susceptible type of growth. Indirect effect seems to be of greatest importance. Infection of highly susceptible varieties occurred in June during height of growth, but in general both infection and development of tumors were retarded by dry soil or high temperature. In controlled soil-temperature experiments infection occurred at 22°C., which is above optimum for growth of potato. Seven additional varieties of American potatoes are provisionally classed as immune, making 34 in all out of 103 varieties tested, but the number of types of immune potatoes remains the same, namely, McCormick, Green Mountain, Cobbler, Spaulding Rose, Ehnola, and Burbank, while the Rural New Yorker, Early Ohio, Early Rose, Triumph, Early Michigan, Pearl, and Up-to-Date types are susceptible. Eggplant, cayenne and pimento peppers, petunia, tobacco, Datura sp., *Solanum integrifolium*, and *S. carolinense* are not susceptible to wart disease. *S. nigrum* and *S. dulcamara* have never been found infected in America. Potato and tomato remain the only demonstrated American hosts. Immunity to wart disease is not affected by presence of leaf-roll or mosaic in the stock.

Leak, a serious transit disease of potatoes. GEO. K. K. LINK.

Field and market observations made during the past few years seem to indicate that leak is virtually coextensive with the potato crop of the United States, and that it is a serious transit and storage disease. In the terminal markets it has been noted in potatoes from New Jersey, New York, North Carolina, Louisiana, California, Washington, Idaho, Montana, Wyoming, Colorado, Nebraska, and Minnesota. The heaviest losses have been observed in Rurals shipped out of Idaho during the hot weather of August and September. The disease seems to occur in potatoes from other sections if the crop is dug and moved during warm weather. Potato men are reluctant to store early potatoes because "they do not keep." One of the reasons for this situation is the menace of leak in both early and late potatoes if dug and stored during warm weather. During September and October of 1921, the losses in Rurals and Burbanks in Idaho storage houses were heavy. It has been demonstrated by isolations and inoculations that most cases of leak are caused by Pythium-like fungi. During the four years only four cases of leak due to *Rhizopus spp.* and two due to *Mucor spp.* were found. Leak has been produced experimentally with the Rhizopus species, but not with the species of Mucor.

Further experiments with inoculated and uninoculated sulfur for the control of potato scab. WM. H. MARTIN.

Fifteen field experiments were conducted with sulfur in 1921. All resulted in a considerable reduction in the number of unsalable scabby potatoes. In six experiments inoculated and uninoculated sulfur was applied at the rate of 600 pounds per acre. The average number of clean tubers on the untreated plots was 8.9 per cent as compared with 33.5 per cent on the plots receiving 600 pounds of uninoculated sulfur and 50.9 per cent for those treated with a similar amount of inoculated sulfur. In three tests where

inoculated and uninoculated sulfur was applied at the rate of 300 and 600 pounds per acre the 300 pound application of inoculated sulfur showed a reduction of 45.7 per cent in the number of unsalable scabby tubers as compared with 39.2 per cent recorded for the plots treated with 600 pounds of uninoculated sulfur.

Additions of formalin to maintain the concentration uniform with direct steam heat in the hot formaldehyde treatment of potatoes. F. M. BLODGETT AND F. R. PERRY.

Nine thousand bushels of potatoes were treated by the hot formaldehyde method of Melhus, using steam discharged directly into the solution for heating. The concentration of the solution was determined at frequent intervals throughout the process. A tank containing about 580 gallons was used. By comparing our results with those of Melhus, as reported in Iowa Research Bulletin 59, it seems evident that the amount of formalin to be added after each fifty bushels treated to maintain the concentration uniform is not proportional to the amount of solution to be heated as suggested by Melhus. It was approximately the same for the 580 gallon tank as for the 200 gallon tank used by Melhus. If the level of solution in the tank is kept constant by condensing steam and addition of water as required, the amount of formalin to be added per bushel would appear to be approximately the amount carried off on a bushel of potatoes, regardless of the size of the tank or the method of heating. In our tests the addition of nine-tenths of a pint per fifty bushels treated seemed sufficient to maintain a concentration of 3.6 grams of formalin per liter.

Potato-seed treatments in western states. H. G. MACMILLAN.

Continued observations and experiments have demonstrated that no standard or uniform potato seed treatment with mercuric chloride can be relied upon to give beneficial results upon certain types of alkaline soils. On some soils treatment results in positive harm to the seed potatoes as compared with untreated control plots. Treatments have to be worked out and modified to meet local soil and water conditions. Formaldehyde is non-effectual against common scab under irrigation where mismanagement in the use of water may cause an excess of soil moisture for an extended period at any time during the early stages of tuber development. Steadily growing plants, either treated or untreated, maintained free from excesses of drought or moisture appear to escape disease a longer time than where improper application of water has occurred.

Yellow dwarf of potatoes. M. F. BARRUS AND CHARLES CHUPP.

A hitherto undescribed disease of potatoes, called "yellow dwarf" because of its effect on the vines, has been observed in New York State. Not only are affected plants dwarfed and the foliage yellowed, but there is a necrosis of the pith and cortical cells in the vicinity of the upper nodes of the stalk. Death of affected stalks takes place from the top downward, beginning with terminal and upper axillary shoots. Tubers from affected plants are usually small, irregular, more or less sessile, brittle, and often badly cracked. There is considerable internal discoloration in the form of rusty brown specks throughout the outer medullary tissue, often extending to the bud end and but rarely to the stem end of the tuber. The number of discolored areas increases with the age of the tuber. A dry rot from the stem end, which finally involves the entire tuber, occurs on badly affected tubers. Even those otherwise apparently healthy can be detected by the more prominent lenticels. The disease affects at least eighteen varieties of potatoes and no variety has been found resistant. The agency causing the disease has not been determined. Infection evidently takes place from the soil and from infected tubers capable of producing plants.

The correlation of foliage-degeneration diseases of the Irish potato with variations of the tuber and sprout. ALFRED H. GILBERT.

The results of studies made at the Vermont Experiment Station during the years 1919–1921 are summarized as follows:—

1. Tubers with spindling sprouts invariably produced either leaf roll plants or plants possessing both mosaic and leaf roll symptoms.

2. Spindliness of sprout was often correlated also with net-necrosis. Eyes in or near necrotic tissue produced spindling sprouts, while other eyes from non-necrotic portions of the same tuber produced sprouts apparently normal. No disease-free plants, however, were secured from tubers either partially or entirely necrotic.

3. Every net necrosis tuber produced plants showing typical and advanced leaf-roll, but not all leaf-roll plants were from net-necrosis tubers.

4. Well marked symptoms of both mosaic and leaf-roll occurring simultaneously in the same plant have been observed in a number of instances.

5. Tuber unit series of plants from leaf-roll tubers showed gradual decrease in size and vigor of plants produced from middle and stem-end buds as compared with those grown from blossom-end buds.

6. No plants free from disease have been secured from any eyes of leaf-roll, mosaic, or net-necrosis tubers.

7. Tubers with apparently normal sprouts may produce plants showing at least mild mosaic symptoms.

The relation of time and temperature to the killing of potatoes and potato mosaic virus. F. M. BLODGETT.

Bliss Triumph potatoes from plants affected with mosaic were treated in water at temperatures from 35 to 80° C. for the purpose of determining, if possible, the relation of time and temperature to the killing of the potatoes and the mosaic virus. It was found that when the logarithm of the time of killing potatoes was plotted against the temperature a straight line resulted so that the relation of time to temperature for this reaction may be approximately expressed by the formula $\text{Log}_{10}\, t = -.107X + 7$ in which t is time in minutes and X is temperature in degrees centigrade. All potatoes that sprouted after this treatment were planted and gave rise to plants affected with mosaic. This would indicate that at least in the range of temperature used the time necessary for the killing of the mosaic virus is longer than for the killing of the potatoes.

Testing seed potatoes for mosaic and leaf roll—II. F. M. BLODGETT, KARL FERNOW, and F. R. PERRY.

The testing of seed potatoes as reported last year, by growing one piece from each potato in the greenhouse, was continued. The outstanding result of this year was that practically all potatoes thus indexed as being affected with mosaic failed to show symptoms of the disease in the field under the conditions prevailing in New York State this year. These were planted in three different counties in different parts of the state. This result would seem to indicate the general unreliability of counts made on mosaic and the impossibility of removing mosaic plants by roguing under such conditions. Tubers indexed as leaf roll grew sprouts generally thinner than healthy potatoes, but not always of the extreme spindling sprout type. From two lots of seed containing about 50 per cent leaf roll, all but three per cent were removed by these methods. Tubers were also indexed by growing one piece from each potato as an early crop in the field previous to planting the main crop. This was only partially successful under the

conditions this year. One-fourth to three-fourths of the mosaic in different tests and about nine-tenths of the leaf roll in one test were removed by this method.

Transmission of potato streak. E. S. SCHULTZ and DONALD FOLSOM.

Preliminary observations in northeastern Maine indicate that streak is closely related to mosaic and similar diseases of the Irish potato, being frequently associated with them in the field, having initial late-season symptoms in new leaves only, usually spreading to all connected parts of a hill, and spreading to other hills with the production either of late-season symptoms the same year or of tuber-transmitted early-season symptoms appearing the following year. In 1921 juice from a streak plant applied to 20 mutilated Green Mountain and Irish Cobbler plants caused infection in 19, with typical symptoms appearing in some in 12 days. Sixty control hills in the same tuber-units, from quartered tubers, remained healthy. In similar series of tuber-units subjected to control inoculations, juice from curly-dwarf Carman No. 3 plants produced mosaic-dwarf infection, while juice from mosaic Bliss Triumph plants caused mosaic symptoms only in the upper leaves of caged hills. The yield of the inoculated plants indicated that the rareness of streak and mosaic-dwarf in commercial fields of northeastern Maine may be due to self-elimination.

Experiments with winter blight or streak of tomatoes. R. E. STONE and J. E. HOWITT.

This is a very common disease in tomatoes grown under glass in Ontario, often causing serious losses and in some instances making the production of a profitable winter crop of tomatoes impossible. The disease sometimes occurs in fields, especially in those very heavily manured. The name winter blight has been given to this disease because it is especially troublesome in the winter crop of tomatoes. It is called streak by the growers on account of the characteristic dead, brown, shrunken lesions appearing on the stems. Experimental work was begun on this disease in 1914 and has been continued every year since. Some of the experiments were carried on in the college greenhouses, but most of them were conducted in large commercial greenhouses. A preliminary report on this disease was published in Phytopathology, Volume 6, No. 2, 1916. The results of the experiments conducted up to that time lead the writers to conclude that no pathogene was responsible for this disease, but that it was the result of soil conditions. Subsequent work has supported these preliminary conclusions. During the past five years almost uniformly satisfactory results have been obtained in the control of this disease by the addition of phosphoric acid and potassium to the soil. In many cases it has been found possible to cause tomato plants to outgrow the winter blight by the application of these fertilizers to the soil. Such treatment has resulted in the saving of large commercial crops of tomatoes in Ontario.

Overwintering of tomato mosaic. MAX W. GARDNER AND JAMES B. KENDRICK.

Over twenty thousand tomato plants were grown from seed from mosaic plants, but no evidence of seed transmission of mosaic was obtained. Mosaic has been found in old tomato fields on the perennial solanaceous weeds *Physalis subglabrata*, *P. virginiana*, *P. heterophylla*, and *Solanum carolinense* and mosaic has been transmitted from each to tomatoes. Rootstocks of mosaic *P. subglabrata* transplanted to a garden in August, 1920, produced mosaic shoots the next spring at an earlier date than tomatoes are transplanted. This weed is very prevalent in central Indiana. Examination of Physalis in nine fields previously in tomatoes showed that a high percentage of the plants showed mosaic the next year and the second year after the tomatoes. Physalis was observed in

65 out of 81 tomato fields and mosaic was noted on Physalis in 35 of these fields and on both Physalis and tomatoes in 29 fields. Tomato mosaic was noted in 60 fields, in 48 of which Physalis occurred. As new fields are used for tomatoes, the reservoir of mosaic in the perennial weed flora will increase each year. The most destructive type of tomato mosaic seems to be of plant-bed origin and the presence of Physalis near plant-beds is especially dangerous.

Further studies on mosaic — I. B. T. DICKSON.

Juice inoculations from mosaic-diseased *Trifolium pratense* were successful in from ten to fifteen days on *T. pratense* 12/23, *T. repens* 3/9, *T. hybridum* 15/32, *T. incarnatum* 2/5, *Medicago lupulina* 3/8, *Melilotus alba* 0/7, and *M. officinalis* 0/5. Using *Macrosiphum pisi* Kalt. (det. by Dr. E. M. Duporte) as the agent of inoculation from mosaic-diseased red clover plants, successful results were *T. pratense* 18/27, *T. hybridum* 15/26, *M. lupulina* 5/8, *T. repens* 4/7, *T. incarnatum* 3/5, *M. alba* 0/8 and *M. officinalis* 0/7. Using *Macrosiphum pisi* Kalt. from healthy *T. pratense* on 7 healthy *T. pratense* plants, no mosaic showed at the end of two months. Tests were conducted from February to September, 1921, in the greenhouse. N. B. X/Y indicates X successful out of Y inoculated.

Further studies on mosaic — II. B. T. DICKSON AND G. P. MCROSTIE.

At Macdonald College out of 1075 *Trifolium pratense* plants 47 per cent showed mosaic in Sept. 1920. The same plants on June 30, 1921, showed 91 per cent mosaic, 6.7 per cent doubtful, and 2.1 per cent healthy. *Macrosiphum pisi* Kalt. was abundant during the early summer this year. Twenty-two mosaic-diseased plants yielded 1,443 seeds or 65 seeds per plant. Twenty-two healthy plants yielded 10,566 seeds, or 484.8 seeds per plant. Inheritance tests in the greenhouse in sterilized soil of the 1,443 seeds from diseased plants gave germination 186, of which 125 were healthy, 37 doubtful, and 24 were diseased within 10 days after germination. Commercial seed from St. Rosalie sown in the field October, after frosts had checked the remaining aphids, showed 5 distinctly diseased plants and several doubtful ones out of approximately 10,000 plants at the time of snowfall November 10. With commercial alsike seed in the greenhouse, of 210 seeds planted, 34 germinated, of which 31 were healthy, 2 doubtful, and 1 mosaic-diseased 10 days after germination.

Mosaic studies. I. E. MELHUS.

Physalis longifolia, a perennial Solanum, has again been found to carry mosaic over winter and transmit it to tomatoes, peppers, potatoes, Petunia, and several wild species. The mottling and crinkling characteristic of mosaic are masked on egg plant (*Solanum Melongena*) in the greenhouse on plants that have passed the seedling stage. The only evidence of an abnormal condition is its smaller size and the infectiousness of its juices on tomatoes, where typical mosaic develops. Stem tissues of mosaic-infected potatoes and tomatoes have been found to contain certain bacteria and other organisms not found in healthy stem tissue. The presence of organisms in mosaic-infected tissue is often markedly constant and probably largely responsible for the marked dwarfing.

Notes on cucurbit mosaic. S. P. DOOLITTLE AND M. N. WALKER.

Continued studies of cucurbit mosaic show that the milkweed, *Asclepias syriaca*, is an important agency in overwintering the disease. Practically all of the mosaic milkweeds found have occurred in the neighborhood of cucumber fields and were evident sources of

primary infection. The milkweed probably becomes infected from adjacent cucumber plants and being perennial acts as a center of infection in succeeding seasons. Cross-inoculation experiments indicate a possible transmission of cucurbit mosaic to the potato. Caged potato plants, on which mosaic cucumber aphids were colonized, developed mosaic symptoms in three out of five cases. Aphids from all of these potato plants, regardless of the presence of mosaic symptoms, were transferred to healthy cucumber plants after four to six weeks and nine out of twenty-one plants inoculated developed mosaic. Aphids from the inoculated potato plants of normal appearance produced mosaic, as well as those from plants showing mosaic symptoms. Potato plants on which healthy aphids were colonized made a normal growth, and aphids from these plants failed to produce mosaic on the cucumber. No mosaic was found on any uncaged potato plants in the plat. Mosaic cucumber aphids transferred to healthy pokeweed plants produced symptoms of mosaic in three out of five cases.

Cucumber black rot caused by Mycosphaerella citrullina. FRED MEIER, CHARLES DRECHSLER AND EMERY EDDY.

Cucumbers shipped from Florida on arrival at the New York market have often been found considerably damaged by various decays. Among the more important of these is a rot attributable to *Mycosphaerella citrullina* (Smith) Gross., a fungus known as occasionally destructive to greenhouse muskmelons and to watermelons in the Southeast, but not hitherto reported on cucumbers. Affected cucumbers develop water-soaked areas that, although enlarging less rapidly than those occasioned by *Rhizopus sp.*, may attain considerable size during the time required for transportation. Cucumbers inoculated with the fungus at Wauchula, Florida, on arrival in New York City, were found badly decayed and in many instances bore an abundance of pycnidia and perithecia. The decay is readily distinguished from similar troubles due to other organisms by the darker color of affected portions and firmer texture of diseased tissues, the firmness being due to the rather compact mycelial development immediately beneath the epidermis preparatory to production of the very numerous imperfect and ascigerous fruiting bodies. (Cooperative investigations Bureau of Plant Industry and Bureau of Markets Inspection Service.)

Further notes on the occurrence of cabbage black leg. J. C. WALKER AND W. B. TISDALE.

The importance of rainfall in the development of black leg, previously emphasized (Phytopath. **10**: 64), has been further studied with special reference to occurrence of the disease in the Puget Sound seed growing region. Nearly simultaneous plantings of infected seed at Madison, Wis., and LaConner, Wash., May 2 and May 7, 1921, were examined at transplanting time on July 7 and July 23, respectively. At Madison 65 per cent of the plants showed leaf or stem lesions and at LaConner 3 per cent. Comparative rainfall records for May, June, and July, respectively, at Madison were 5.13, 3.52, and 2.46 inches; and at LaConner, 1.89, 1.90, and 0.00 Thus with the rainfall somewhat above normal at LaConner only a very slight development of black leg occurred and with the dry weather, which normally continues through July and August, it is doubtful whether this amount of disease would have survived after transplanting. Black leg has never been reported from this region. Moreover, one seed field at LaConner, grown from stock seed which developed 75 per cent black leg under Wisconsin conditions, showed no signs whatever of the disease. These facts, in view of the limitations of seed treatment, suggest the feasibility of growing black-leg-free seed in the Puget Sound region.

Observations on the spore content of the upper air. E. C. STAKMAN, A. W. HENRY, W. N. CHRISTOPHER, AND G. C. CURRAN.

As a part of the rust epidemiology studies made by the Office of Cereal Investigations of the United States Department of Agriculture during the spring and summer of 1921, aeroplanes were used to ascertain the spore content of the upper air. Ordinary microscopic slides, smeared with vaseline, were placed in a mechanical spore trap which could be manipulated from the cockpit in such a way that it was possible to expose the slides one at a time for as long a period as desired, at various altitudes and at widely separated points. In addition to rust spores, numerous spores of Helminthosporium, Alternaria, Cladosporium, Cephalothecium, and Ustilago were caught at elevations up to ten thousand feet. Some were caught at higher altitudes. Many pollen grains also were caught. Alternaria spores which had been obtained at eleven thousand feet germinated readily. The germination tests with the rust spores were inconclusive.

Investigations on Puccinia helianthi Schw. D. L. BAILEY.

The uredinial stage develops six to eight days after inoculation. The age of the host does not influence the degree of infection. Infection follows six hours' incubation. Uredinia will not develop below 10° C., but the mycelium will remain dormant in infected leaves for at least a month at this temperature and will develop subsequently. Optimum temperature for urediniospore germination is about 18° C. The germ tubes enter through the stomata. Teliospores germinate either immediately or after a rest period. The promycelium typically produces sporidia, but it may branch, or the cells may produce germ tubes. The aecial stage is usually produced, although it sometimes is omitted. Aeciospores remain viable about three weeks. Penetration stomatal. In 1920 urediniospores from *Helianthus subrhomboideus* Rydb. and urediniospores and heliospores from *H. scaberrimus* Ell., *H. Maximiliani* Schrad. and wild *H. annuus* L. heavily infected cultivated sunflower. The same cultures on eight horticultural and cultivated varieties showed no specialization. This year Mammoth Russian shows distinct resistance to collections of rust from *H. grosseserratus* Martens, *H. Maximiliani* Schrad., and two cultures from *H. hirsutus* Raf. One collection from *H. tuberosus* L. gave two types of infection, one very susceptible and one resistant. Apparently, therefore, there are biologic forms.

Studies on Septoria diseases of cereals and certain grasses. GEORGE F. WEBER.

During the past two years, investigations have been conducted at the University of Wisconsin on the Septoria diseases of cereals and certain grasses and it has been found that there are a number of closely related species on these hosts. Morphologically these species differ only slightly. *Septoria tritici* Desm. and *S. glumarum* Pass., which occur on wheat and rye, differ distinctly morphologically. Both species cross-infect readily on these hosts and both species also infect *Poa pratensis*. No other host has been found susceptible to either species. *S. secalis* Prill. and Delacr. has been found on rye. It infects rye readily, but no other host has been found susceptible. The species on barley seems definitely to be *S. passerinii* Sacc. It infects various barleys readily, but no other host has been found susceptible. A species on oats seems definitely to be *S. avenae* Frank. It infects various species and varieties of oats, cultivated and wild, but no other host has been found susceptible. *S. agropyri* E. and E. infects *Agropyron repens* readily, but does not infect cereals. A form on *Poa pratensis*, apparently *S. graminum* Desm., infects *Poa pratensis* readily, but does not infect cereals.

Relation of temperature, soil moisture, and oxygen to the germination of the spore of Ustilago avenae. EDITH SEYMOUR JONES.

In connection with investigations of the physiological factors affecting the infection of certain species of Avena by *Ustilago avenae* (Pers.) Jens., certain of these factors, temperature, soil moisture, and oxygen were studied separately in their relation to the germination of the spore of the fungus. With regard to temperature, the cardinal points were found to be: Minimum about 5° C., optimum 15 to 28° C, and maximum ranging between 31 and 34° C. Experiments with soil moisture were conducted by duplicating as closely as possible the conditions under which germination takes place in the field, using three different temperatures, 10 to 13°, 20 to 24°, and 30 to 33° C. When the moisture in the soil at these temperatures reached 60 per cent of the water-holding capacity, germination percentages decreased slightly and were greatly reduced at 80 per cent. The supposition that a lack of oxygen in this soil of high water content might perhaps be responsible for this marked decrease led to attempts to germinate spores in the absence of oxygen. These experiments demonstrated for this fungus the hypothesis commonly assumed, that spores will not germinate in a liquid which is not exposed to oxygen. (Cooperative investigations by the Wisconsin Agricultural Experiment Station and the Office of Cereal Investigations, U. S. Department of Agriculture.)

Fusaria of wheat and corn. C. D. SHERBAKOFF.

Recently the writer made cultural examination of a number of samples of wheat and corn seed. These examinations, and the cultures received from Kurtzweil, show that in Tennessee, as in other states, the most common Fusarium of wheat is *F. graminearum* Schwabe (*Gibberella Saubinetii*) and of corn, *F. moniliforme* Sheldon. Several times corn seed yielded cultures of Fusaria of the Elegans section. Only in a few instances *F. graminearum* was isolated from corn seed; but, the perithecial stage of this fungus was often found on corn stalks. *F. moniliforme* was not common on wheat seed. Among the Fusaria answering Sheldon's description of *F. moniliforme* are several that differ from each other in more than one important character and are thus apparently different organisms. For this reason and because none of the previously established sections of the genus Fusarium fits the characters of these corn fungi, a new section, Moniliform with characters as follows, is proposed: Macroconidia of intermediate Roseum-Elegans type, with very thin walls, mostly three-septate; microconidia also in chains; no chlamydospores; color of substratum from none to violet.

The effect of Cronartium ribicola upon Ribes. L. H. PENNINGTON.

Four seasons' observations upon certain Ribes bushes in localities where *Cronartium ribicola* is abundant have shown that the rust often affects seriously some species of Ribes. Individual bushes of *Ribes Cynosbati, R. rotundifolium,* and *R. glandulosum* died after early defoliation for three successive seasons. In certain restricted localities, where there was a heavy infection of the pines, the Ribes have all been killed. Sprouts from the base of dying bushes did not make any considerable growth, for they also were defoliated and died within two to three years. Early defoliation and the subsequent death of Ribes are both factors in the control of the disease upon pine. Early defoliation greatly reduces or prevents entirely the formation of telia, and the death of the Ribes may occur before all the pines in that location have become infected. Under certain conditions, where there has been a heavy seeding of pine, many of them may be infected and yet enough of them escape to insure a good stand. The destruction of Ribes by the rust has led to error in determining the distance that infection has spread from Ribes to pine.

Notes on Cronartium ribicola. PERLEY SPAULDING.

Infected leaves of *Ribes nigrum* and *R. cynosbati* almost invariably roll the edges upward when drying so that the entire lower surface is exposed for a maximum freeing of the sporidia. In September bushes of *R. cynosbati* with a full complement of leaves bore none of the fungus, while bushes that were infected had relatively few leaves. Telia collected on dead or dying leaves (even of *R. nigrum*) or on dead spots on living leaves, in warm weather of September and October, did not germinate when collected; but those on active, green leaves from the same bushes germinated readily. Conditions in a living leaf bearing telia, which is suddenly killed, seem to favor maximum germination. Cold is known to stimulate germination of all the spores of *Cronartium ribicola.* The above observations led to the belief that heavy frost would stimulate germination and this has proven to be the case. Maximum germination has been secured on leaves exposed to and killed by frost, or which have persisted on the bush until snow fell. Such leaves have borne readily germinated telia as late as December 3 in Vermont. *Ribes nigrum* leaves collected October 11 and since then exposed to moisture out of doors but not to full sunlight are still giving good germination of the telia. When conditions are right some of the telia germinate themselves in the mosquito netting bags. This has happened only since snow was on the ground.

A preliminary report on cross-inoculation experiments with strains of Cladosporium from stone fruits. M. BENSAUDE AND G. W. KEITT.

Morphological studies and cross-inoculation experiments with strains of Cladosporium from stone fruits have been undertaken with the aim of furthering our understanding of the relations of these pathogenes to their hosts and to one another. The host plants in the experiments here reported were *Amygdalus persica* L. (Elberta), *Prunus armeniaca* L. (Superba), and *P. americana* Marsh. (seedling), located in plats previously described by the junior author (Keitt, G. W. Inoculation experiments with species of Coccomyces from stone fruits. Jour. Agr. Res. **13:** 539–569. *pl. 55-59. f. 1-3.* 1918. See p. 545–546). Similar trees, uninoculated, served as controls. The strains of Cladosporium used were taken from *A. persica* and *P. americana.* The inocula were prepared by washing cultures or host organs on which Cladosporium was sporulating with sterile distilled water, and were applied to leaves and twigs by means of sterile atomizers. For three days after inoculation the experimental plants were covered with a moist chamber, which has been described previously (loc. cit., p. 546–547). The outstanding results were that the fungus from *A. persica* cross-infected *P. americana* and *P. armeniaca,* and the strains from *P. americana* crossed to *A. persica* and *P. armeniaca.* The uninoculated plants developed no infection.

Coconut bud rot in the Philippines. OTTO A. REINKING.

Investigations in the Philippines have proved that the infectious type of coconut bud rot is caused by a specific fungus in the Phytophthora group. Inoculation studies conducted with bacteria seem to show conclusively that the true bud rot is not produced by these organisms. Inoculations with the Phytophthora, isolated from a diseased tree, in all instances caused infection through injuries and in the majority of cases caused infection of the uninjured coconuts. There are two types of bud rot in the Philippine Islands, the real infectious type caused by the Phytophthora, and a secondary type following some injury, such as beetle injury, and caused primarily by the invasion of bacteria in the weakened tissue. The first type accounts for the epidemics that occur principally in the chief coconut sections in Laguna Province. The second type assigns

the cause for the other scattered cases of disease found throughout the rest of the archipelago. The Phytophthora isolated from coconuts is similar to the Phytophthora producing the black rot and canker of cacao and appears to be identical with other Phytophthoras isolated from various other diseased hosts. Because of the prevalence and destructiveness of these Phytophthoras, their investigation is a field of just importance in tropical plant disease studies.

nie Aimlprary report on a serious twig blight of American elm. FREDA DETMERS.

The appearance of infected trees is described and illustrated. The causal organism from careful and repeated observational examination of dying trees is thought to be *Poronidulus conchifer* (Schw.) Murrill, a small bracket fungus of the Polyporaceae. The fungus is described in detail and illustrated. The mycelium is perennial, ramifying through the leptom and cambium and invading the sap wood, coloring the latter brown. Each year annual hymenophores are produced on dead branches, through the distribution of whose spores infection is disseminated. Premature defoliation is a symptom of infection, followed soon by the death of the shoot and later the death of the larger branches until the entire crown is involved. Fragment cultures from infected tissues and fruiting bodies of the fungus were made. A history of the outbreak in Ohio is given and attention called to the fact that infection has evidently existed for a number of years and reached its culmination in a number of large, fine trees in widely separated areas in Ohio during the past summer. A brief résumé is given of the description and naming of the fungus.

A hybrid bean resistant to anthracnose and to mosaic. DONALD REDDICK.

From published work of others it is known that White Imperial is resistant to strain alpha of *Colletotrichum lindemuthianum*, practically immune to strain beta, and that it is somewhat tolerant to mosaic. Robust is immune to strain alpha and susceptible to strain beta; it is immune to mosaic. From hybrids of these two varieties families of plants have been isolated which in the sixth generation (five inoculations) are immune or highly resistant to both diseases. Some of the plants are more resistant to anthracnose than either parent. In a few of the families commercial types are approximated, but commercial possibilities are not yet determined. No genetical studies have been made.

A yeast parasitic on lima beans. S. A. WINGARD.

Examination of lima beans from eastern Virginia, which showed numerous dark sunken areas on the cotyledons, having the appearance of bacterial origin, revealed the presence of the vegetative cells, asci, and ascospores of a yeast, a species of Nematospora. Some seed which had been attacked in the early stage of development were completely dried up, being no more than one-tenth normal size. The evidence strongly suggests that the yeast is parasitic and the disease appears to be of economic importance. Pure cultures have been secured and infection studies are in progress.

Colletotrichum pisi Pat. on garden peas. R. E. VAUGHAN AND FRED REUEL JONES.

Anthracnose of the garden pea was first found in Ecuador by von Lagerheim and has been recently described by Hemmi in Japan. In 1912 this disease was found causing severe injury to peas in one locality in Wisconsin. In 1921 it appeared in another locality in this state as a cause of serious disease. The fungus has been cultured and in artificial inoculations, as well as in the field, found to be one of the most destructive foliage

parasites known. The similarity of the symptoms of this disease to those of the disease caused by *Ascochyta pisi* may be an explanation for the fact that it has not previously been reported in the United States.

Spraying and dusting for the bacterial and late blights of celery in western New York. H. W. DYE AND A. G. NEWHALL.

During the past three years equivalent amounts of 5–5–50 Bordeaux mixture and 15–85 copper-lime dust have been tested comparatively for the control of celery blights caused by *Bacterium appii* Jagger and *Septoria Petroselina* Desm. var. *appii* Br. and Cav. Comparative treatments were made using both power and hand machines. Applications were made at seven and ten-day intervals, beginning with the first appearance of blight. With uniform consistency throughout a considerable number of trials, almost complete reduction of blight development was obtained. The spray and dust appeared to be equally effective in controlling these blights, and both gave similar increases in yields over the checks.

First progress report on "yellows"-resistant Golden Self-blanching celery. G. H. COONS AND RAY NELSON.

Yellows of celery, due to *Fusarium sp.*, is present in all celery-growing areas in Michigan and is reported from several other states. Certain green varieties, notably Easy Blanching, under cool conditions are tolerant to the disease, but Golden Self Blanching is so susceptible as to make its culture impossible. Seed from a plant of Golden Self Blanching, selected from a field showing practically 100 per cent loss, has been extensively tested in "sick" soil in both greenhouse and field against standard varieties of celery and in particular against pure-line strains of Golden Self Blanching. Almost complete failure of all plants except the resistant celery occurred. The resistant celery produced about 90 per cent of a crop, in spite of most severe epidemic conditions, brought about by the high soil temperatures. About 50 plants grown in the winter of 1920–21 in sick soil were brought to maturity and seed obtained. Due to extremely hot season the seed production was light. Commercial distribution of seed will therefore be delayed. The original isolation was a plant of the best Golden Self Blanching type and the progeny saved has been held to this standard.

The bottom-rot disease of western New York lettuce. H. W. DYE.

This most destructive disease of Boston head lettuce on New York muck land is caused by Rhizoctonia. Rusty lesions on the midribs and a rotting away of the leaf blades of the lower leaves is characteristic. A blackened, erect "stump" is the advanced stage of the disease. The greatest loss results on older, damp muck. The usual control measures attempted for soil-infesting organisms are ineffective or impractical. No lettuce seems to possess any resistance, though the more erect types are unaffected by bottom rot because of their disease-escaping habit. Green, erect, Romaine lettuce was hybridized with the yellow, spreading Big Boston type so affected by bottom-rot. Hybrid plants have been secured, which promise to escape bottom-rot, to possess the Big Boston color and quality, and to be but slightly more erect.

Downy mildew: A transit disease of lettuce. GEO. K. K. LINK.

Downy mildew of lettuce, caused by *Bremia lactucae*, has been observed in the markets in lettuce shipments from California, New York, Texas, and Washington. It causes heavy losses. At times the lesions show the typical angularity of field lesions,

but generally their borders have become irregular and indefinite, indicating enlargement in transit. Observations made in California indicate that new lesions develope in packing houses, on loading platforms, and probably in the early stages of transit. However, spread and development of the disease in transit are slight, and in the markets the lesions generally appear as more or less angular, brown to black areas, with rather definitely marked outlines. Although the losses caused by these lesions are heavy, the most severe losses are due to organisms which invade the lesions and then spread to healthy tissues. Bacteria and Alternaria spp. are the prevalent secondary invaders. Because of these, especially the former, downy mildew is one of the most serious transit diseases of California lettuce.

Storage rot of carrots caused by a new species of Alternaria. FRED MEIER, CHARLES DRECHSLER, AND EMERY EDDY.

Dealers on the New York market have frequently complained of wastage due to decay of carrots in transit and storage. In addition to other and better known decays, a trouble has appeared characterized by softening and blackening of the affected tissues, beginning at any place on the surface of the root, but most frequently finding inception at the crown and extending down into the central core. On the surface of the disorganized portions, the causal organism develops as a grayish-black mat mycelium, the fuliginous hyphae of which bear an abundance of darker sporophoric branches, producing usually a single large muriformly septate spore. That the fungus is nevertheless not to be referred to the genus Macrosporium becomes evident on cultivation, for on media permitting protracted development a catenulate habit ultimately becomes apparent. The parasite differs markedly from *Macrosporium carotae* E. and L., the cause of leaf blight, although field observations carried out in Massachusetts and on Long Island indicate that attack by the latter fungus may predispose roots to subsequent decay in storage. (Cooperative investigations Bureau of Plant Industry and Bureau of Markets Inspection Service.)

A new disease of asparagus. MEL T. COOK.

During the late summer of 1921 our attention was called to the slow dying out of asparagus plants over circular areas. The plants are stunted, gradually turn brown and finally die. A careful study of the diseased plants showed brownish lesions on the part of the stems below ground and a heavy infection with *Fusarium sp.* We then recalled that from time to time for several years past, dwarfed shoots have been sent to us during the cutting season and that *Fusarium sp.* was the only organism found on them. Our studies are not complete, but all evidence up to the present time indicates that the troubles are due to *Fusarium sp.*

Bacterial root rot of horseradish in New Jersey. R. F. POOLE.

A bacterial root rot of horse-radish has caused losses ranging from 4 to 28 per cent on farms near Newark where this plant is cultivated. The main source of infection has been the dissemination of the disease in the storage pits. Roots carefully selected at digging time and bedded under normal conditions over winter developed from 25 to 50 per cent infection in the pits. When planted the diseased roots either failed to germinate or produced stunted plants. Good progress has been made in controlling the disease by cutting an inch from both end of seed roots and before planting discarding all that showed discoloration due to disease. Treatments with bichloride of mercury 1 to 1,000 for 15 minutes and formaldehyde 3 pints to 50 gallons for 30 minutes reduced the losses still more when the cut and selected roots were treated.

Pathogenicity of Macrosporium parasiticum. N. G. TEODORO.

Macrosporium parasiticum Thümen has generally been considered a secondary parasite to onion mildew and incapable of independently infecting the onion. In Wisconsin, where mildew seldom occurs, *M. parasiticm* is found repeatedly, apparently causing distinct lesions on leaves and seed stems of onion and often girdling the latter. Experiments were undertaken to determine the pathogenicity of the organism. Greenhouse inoculations were made with mycelium from young cultures, applied through wounds or directly to the uninjured tissue. Characteristic symptoms of the disease were produced in both cases. Inoculations in the field with mycelium and with suspension of conidia also yielded positive results. Infection occurred more readily when plants were kept moist for a short time after inoculation by means of moist chambers. Results indicate that *M. parasiticum* is capable of acting independently as an aggressive parasite. The cultural characters of the fungus are being studied in comparison with *M. porri*, which also occurs commonly on onion, and with an undescribed species of Macrosporium causing a bulb rot of onion (Phytopathology **11**: 53).

The decay of various vegetables and fruits by different species of Rhizopus. L. L. HARTER AND J. L. WEIMER.

A study has been made of the susceptibility of 27 different hosts to infection by the following species of Rhizopus: *nigricans*, *reflexus*, *microsporus*, *arrhizus*, *tritici*, *nodosus*, *maydis*, *delemar*, *oryzae*, *artocarpi*, and *chinensis*. *R. microsporus* and *chinensis* infected only a few of the hosts. The species of the intermediate temperature group, which includes *R. tritici*, *nodosus*, *maydis*, *delemar*, *oryzae*, and *arrhizus*, are more vigorous parasites under artificial conditions than *R. nigricans*, *reflexus*, *microsporus*, and *artocarpi*, the representatives of the low-temperature group. *R. nigricans*, however, seems to be the predominating species causing decay of vegetables and fruits in storage and on the market. The different hosts differed in the method required to bring about infection. Beets, Irish potatoes, and those hosts apparently low in water content could be infected only by the use of the "well" method. Those hosts with a high water content could be infected by merely inserting the spores and hyphae into a wound. A wound was required for infection in the case of all the hosts, with the possible exception of the peach. Ripe peaches, with no apparent wounds, could be infected by immersing in a spore suspension.

The control of angular leaf spot of cotton. C. A. LUDWIG.

A method of seed treatment for preventing angular leaf spot of cotton which was devised at the South Carolina Experiment Station a few years ago was given a supplementary field test during the past season. The method consists in delinting the seed with strong sulphuric acid, washing, treating with mercuric chloride solution, washing, and drying. The treatment was found entirely satisfactory. The full account is in the hands of the editor of Phytopathology.

Cotton wilt a seed-borne disease. JOHN A. ELLIOTT.

Isolated wilt-infected cotton plants in otherwise healthy fields called attention to the probability that the disease was seed-born, as has been suggested by other investigators. In 1920 a large field of isolated virgin soil was planted with acid-delinted, disinfected seed. A few cases of wilt occured in this field. In another small isolated patch grown from disinfected seed far from the cotton region a similar occurrence of wilt was noted. A considerable quantity of seed was collected from plants which died of wilt, delinted

with concentrated sulphuric acid, strongly surface sterilized with 1: 1000 50 per cent alcohol solution of corrosive sublimate, and germinated on sterilized filter paper in petri dishes. Approximately 3 per cent of the seeds gave cultures of *Fusarium vasinfectum*. Other fungi, especially Colletotrichum and an unidentified Fusarium, were more abundant.

Stem rot diseases of sweet potatoes in New Jersey. MEL T. COOK AND R. F. POOLE.

The stem-rot diseases of sweet potatoes caused by *Fusarium hyperoxysporium* and *Fusarium batatis* (Wr.) are abundant in New Jersey. From 35 to 65 per cent infection has been found by splitting green vines at digging time. Infected vines frequently produce more and smaller potatoes than healthy vines. The disease is widely distributed and is severe throughout the Camden and Salem areas, being most destructive on light sandy soils. Seed selected at digging time produced slightly better sprouts than unselected seed when set on infected soils. Sprouts that become very large and hardened due to drying of hot-bed, are very susceptible to infection after they are set in the field. Sprouts set in the field a short time after they became large enough were less susceptible. The Big Stem varieties are more resistant to stem rot than the smaller-stem varieties. The Big Stem Jersey strains developed from sports vary in resistance to the stem rot disease and they are offering an interesting comparative study of stem-rot resistance.

The species of Rhizopus responsible for the decay of sweet potatoes under storage conditions. J. I. LAURITZEN AND L. L. HARTER.

Rhizopus tritici and *R. nigricans* are the species chiefly responsible for the decay of sweet potatoes known as soft rot, *R. tritici* at the higher temperatures and *R. nigricans* at the lower, the two overlapping between 20° C. and 30° C. Although other species are capable of causing soft rot, they do not seem to do so under the storage conditions at Washington. *R. tritici*, *R. reflexus*, and *R. artocarpi* can not compete successfully with *R. nigricans* when sweet potatoes are inoculated with any one of these organisms along with *R. nigricans*. Even though sweet potatoes are inoculated with spore suspensions of high concentration of *R. tritici*, *R. oryzae*, and *R. reflexus*, *R. nigricans* nearly always causes more decay than any of these species. *R. nigricans* causes far more decay than any or all other species; in fact it is the principal agent of decay. *R. tritici* is not normally a factor, because sweet potatoes are stored as a rule at a temperature below which it operates.

Preliminary report on a study of the wildfire disease of tobacco. C. M. SLAGG.

In connection with studies upon the wildfire disease of tobacco caused by *Bacterium tabacum* Wolf and Foster, morphological studies have been made of the causal organism isolated from diseased specimens collected in various northern tobacco growing districts. As far as symptoms are concerned the disease in question is undoubtedly identical with that first described by Wolf and Foster in North Carolina. Isolations from North Carolina material have been included in our studies. There are at least two morphological characters, and certain cultural characters, in which our organism differs from the original description. It is believed that the morphological differences may be of sufficient interest to warrant mention here. For comparison the data may be summarized as follows:

Source of data	Extreme dimensions in microns		Average size in microns		Number of flagella
	Width	Length	Width	Length	
Original description, Wolf and Foster, 1917	0.9–1.5	2.4–5.0	1.2	3.3	1
Strains collected in Connecticut, Kentucky and other states	0.5–0.75	1.4–2.8	0.6	1.7	3–6

The wildfire disease has caused concern in several tobacco growing states where it has recently been introduced. Since at least two other bacterial leaf spot diseases of tobacco have been described in the United States, the importance, from a diagnostic standpoint, of checking the morphology of the wildfire organism is evident.

Experimental evidence relating to the nature of the mosaic virus. JAMES JOHNSON.

Chambers in which plants can be grown under controlled temperature and humidity conditions have been constructed. It has been found that the optimal temperature for the mosaic disease of tobacco lies close to 28–30° C. The maximal temperature for its expression is approximately 37° C., that is, at this temperature inoculated plants fail to develop symptoms, and leaves showing mosaic symptoms gradually "recover." Similar results may follow from low temperature exposure. Quantitative determinations of enzymes, said to cause mosaic, indicate that enzymes are not correspondingly reduced by exposure of plants to the higher or lower temperatures; in fact, it is probable that the optimal temperature for their activity lies close to 37° C. It seems, therefore, that these results furnish evidence against the enxymatic theory of mosaic while at the same time they favor parasitic hypothesis, since the temperature curve for the development of mosaic corresponds closely with that of the development of many of the plant pathogens.

Non-parasitic leaf spots of tobacco. JAMES JOHNSON.

The tobacco leaf is subject to a great variety of spot diseases, commonly called "rust." The list of these shown to be of parasitic origin is growing, but many are non-parasitic in nature, as has been shown by repeated attempts at culturing from such spots. Many opinions as to the cause of these spots are to be found, principally in semi-scientific literature, and experiments are being conducted to test various plausible theories. These spots can not all be assigned to the same cause, and the symptoms from any one cause may vary considerably. An attempt is being made however to classify these spots as to symptoms and cause. Tentatively they are found to fall into four main groups, namely, those due to: 1. an inherent physiological predisposition to spotting, 2. to unbalanced nutrition, 3. to absorption of toxic agents, and, 4. to toxic agents applied externally. These groups may be illustrated by the following cases: Certain varieties, especially Sumatra and Connecticut Broadleaf, commonly show spots when other varieties do not. A strain originating from a cross between two varieties not predisposed to spotting became extremely spotted. Shortage of phosphorus seems to be a predisposing factor. Certain soils rendered toxic by sterilization may produce marked spotting. Spotting also commonly results from spraying with insecticides. The prevailing environmental conditions seemingly affect the expression in all cases.

The stem and bulb infesting nematode in America. G. H. GODFREY.

During the past season the stem and bulb-infesting nematode, *Tylenchus dipsaci* (*T.*

devastatrix) has been found to occur in America on red clover, alfalfa, strawberry, and daffodils. On the first three hosts it is doing serious damage locally in Oregon and Idaho. Yields are reduced and attacked plants are killed prematurely. On red clover and alfalfa pronounced swellings occur on the above-ground parts of the plants. In the late fall or early spring these swellings are as a rule confined to stem bases in the crowns of plants. During the growing season the nematodes are carried up with the growing stems and typical swellings may occur a foot or more above ground. On the strawberry, swellings or galls, sometimes accompanied by abnormal red coloration, occur on leaves, leaf-petioles, stolons, flowers, and flower pedicels. On daffodils the disease was found in a bulb garden in Chicago, attacking the leaves and causing small, yellowish, slightly swollen spots. In Europe the disease is serious on both daffodils and hyacinths, attacking the leaves first and later penetrating to the bulbs. In severe cases the plants become dwarfed and distorted. The disease should be watched for generally on all susceptible plants, and any new occurrence promptly reported.

Fusarium rot of gladiolus. L. M. MASSEY.

One of the three diseases of gladiolus most commonly met with is one to which the name "Fusarium-rot" has been given. The corms become infected in the field, and the rot advances in storage. Lesions on the corms are slightly sunken, more or less circular in outline, have definite margins, and frequently have definite and conspicuous concentric markings or zones. The color of the lesions varies somewhat with that of the corms, but is frequently hazel, bay, burnt sienna, Sanford's brown, or mahogany red, (Ridgway). A Fusarium has been consistently isolated from typical lesions. Inoculations both in the field and under glass have established the pathogenicity of the fungus. Assistance in the determination of the fungus was given by Dr. C. D. Sherbakoff, who concurred with the writer in his decision that the fungus agrees closely with *F. oxysporum* Schlecht. Certain minor morphological differences and the results of inoculations on several hosts indicate that the fungus should be given at least a new varietal name.

Soil temperatures obtained under a steam pan. N. REX HUNT AND F. G. O'DONNELL.

Soil temperatures under the steam pan were obtained by the use of electrical thermocouples buried at different levels in the soil under the pan. The inital temperatures were taken and steam turned on, temperatures being recorded every five minutes until the soil at all depths had begun to cool. Temperatures varied somewhat with the soil type and condition and with the condition of the steam (whether "wet" or "dry"). Variations in steam pressure had a marked effect on the rapidity of penetration. Steaming for seventy five minutes raised the soil temperature to near the boiling point for a depth of seven inches or more, using a 6 x 9 ft. steam pan, with steam at 90 lbs. pressure, from a ¾ inch pipe. The pressure gauge was read before turning the steam on, as the pressure was lost as soon as the steam entered the pan. With forty minutes of steaming the following temperatures were obtained: At one inch, 98° C. in 45 minutes after steam was turned on; at five inches, 50° in 80 minutes; at eight inches, 37° in 125 minutes. The pan was removed thirty minutes after steam was shut off. The rise and fall of the soil temperature was somewhat irregular as shown by curves based on the data obtained.

Printing plate cultures. F. G. O'DONNELL.

The direct printing of plate cultures, while somewhat generally known is very little used. *Method*: Plates are placed on sheets of photographic or blue print paper and ex-

posed without removing the plate covers. Paper is developed as usual. A hard glossy paper gives the best results. Length of exposure must be determined by trial. Prints can be made at less than two cents apiece for materials. To facilitate printing of large numbers of plates an inexpensive printer was designed.

The dissemination of plant diseases by seed. C. R. ORTON.

In the profitable production of plant crops there are four factors of paramount importance to be considered. These are 1. the soil, together with the maintenance of its fertility; 2. the seed; 3. the protection of the growing crop against diseases, including insects; and 4. meteorology. The first three are subject largely to manipulation, the last is beyond control to any great extent. Of the three factors controllable by human agencies, that of the seed is of importance from five standpoints, viz. 1. inherent resistance to disease, 2. freedom from disease, 3. vitality, 4. quality, 5. productiveness and adaptibility. Up to the present the development of improved seeds has been almost wholly along the last three lines. The question of resistance to disease has been attacked by several workers, with noteworthy results; that of freedom from disease has been agitated intermittently by various agencies and some progress made, but the national and international importance of this problem has apparently not been realized by those most concerned. At the present time the evidence is conclusive that many of the diseases of crop plants are disseminated upon or within the seed to a greater or less extent. It is undoubtedly this fact which accounts for the present wide distribution of many important plant pathogenes. The importance of this situation should be realized by the public, as well as commercial interests and scientific workers. A full discussion of this problem and the methods of organization for its attack is desired.

Third progress report on apple scab and its control in Wisconsin. G. W. KEITT.

The studies previously reported have been continued and a series of dusting experiments added. The early spring and summer were so dry that scab development was insufficient to furnish an adequate test of the efficiency of the various spray and dust programs. The first ascospore discharge was observed at Sturgeon Bay on May 13 and the last on June 16. No heavy or protracted discharges occurred. Inoculations on leaves and fruit in the experimental orchards during the last two years have shown incubation periods of from 14 to 18 days. Orchard observations in 1916 and subsequently and infection experiments in the last two years have shown that leaves and fruit of the varieties studied are much more susceptible to scab when young than in later stages of development. The upper surfaces of leaves ordinarily became highly resistant before they were fully expanded, while the lower surfaces of mature leaves might develop a diffuse, sooty type of infection after a much prolonged incubation period. These phenomena appear to be significant in relation to the nature of disease resistance.

Susceptibility of apple root-stocks to black root rot. F. D. FROMME.

Inoculation of apple trees on seedling roots with *Xylaria sp.* (*X. digitata*?), the species which commonly causes black root rot of apple in Virginia, produced infection and death of three-fourths of the trees within a period of three years. Similar inoculation of trees on Northern Spy roots produced infection of only one-fifth of the trees. One-third of these were only slightly infected. The others died within three years. Similar resistance was shown by other Northern Spy rooted trees which were set in orchards as re-

plants following trees killed by root rot. The Northern Spy root appears to be markedly superior in resistance to the seedling root stocks used by nurserymen.

Origin of apple-blotch cankers. MAX W. GARDNER.

Observations in Indiana on blotch (*Phyllosticta solitaria*) on Northwestern Greening have shown that a very high percentage of the twig cankers occur at leaf scars. Basal petiole lesions are very abundant on the leaves of the lower limbs. Many cases have been observed in which the petiole lesion had actually crossed over to the twig in the fall, but most of the cankers do not appear until the second season. Careful observations between September, 1920, and September, 1921, have shown that most of the cankers on the 1920 twigs appeared during April and May of 1921. Cultural tests, in which the fungus was isolated from petiole segments and leaf scars well below the lower margin of a petiole lesion, indicates that the mycelium may grow down within the petiole and cross the abscess layer before the leaf falls. Another type of twig lesion seems to result from bud scale infection. Direct infection of suckers and water sprouts between the leaf scars is of common occurence. The standard blotch-spraying program gives an almost perfect control of petiole infection and apparently of twig infection.

Studies on the infection and control of crown gall on apple grafts. I. E. MELHUS AND T. J. MANEY.

Infection and possible control of crown gall on apple grafts has been studied for the past five years at the Iowa State Experiment Station. It has been found that infection of apple grafts is readily accomplished by dipping the grafts, just before planting, in a viable bouillon culture of *Bacterium tumefaciens*. The majority of the galls occur at the union. The stock is less liable to become infected than the scion. Grafts are equally susceptible to the organisms whether the callus is normal, excessive, or slight. Most of the infection takes place the first year during the formation of the callus at the union. Well-made and poorly-made grafts showed little difference in the amount of infection. Using an unusually large, heavy string wrap over the union leads to girdling and excessive callusing of the trees, which seem to facilitate crown-gall infection. Cloth applied over the union as a wrapper, either with or without string, decreases the amount of crown gall. Scion wood cut from trees infected with crown gall at the union, did not show any increased amount of infection. Hairy root seedlings when used as stocks did not transmit hairy root to the scion, but the stock portion of the graft usually remained infected. Surface disinfection with soluble fungicides is injurous to the grafts. Fungicides which go into solution slowly, such as lead arsenate and Bordeaux mixture, have a much less injurious effect on the callusing process. A strong Bordeaux mixture, 25–25–50, decreases the amount of crown gall, but also decreases the stand. This dilution has a marked preserving action on the string wrapper, which tends to aid girdling. A resin sticker added to Bordeaux mixture increases its toxic action and reduces the stand. The addition of lead arsenate or soaps to Bordeaux mixture does not increase its toxic actions on the grafts, but rather increases its adhesiveness and its fungicidal efficiency. More dilute Bordeaux mixtures did not reduce the stand and proved nearly as beneficial in reducing crown gall as the stronger mixtures. The use of Bordeaux mixture, 8–8–50, with or without lead arsenate, reduced the percentage of crown gall about 66 per cent over the checks, and nearly 50 per cent over the mean per cent of crown gall in all the checks in the Wealthy variety.

Studies of crown gall. A. J. RIKER.

Studies of crown gall on tomato and raspberry have been made at Madison, Wis.,

during the last two years with an organism isolated from black raspberry, which conforms in most respects with the description of *Bacterium tumefaciens* Smith and Town. No standard varieties of red or black raspberries were found to be strikingly resistant to this disease. No evidence obtained indicated that infection had an immunizing effect. Infection in tomato was secured only through wounds and at temperatures below 30° C. The organism was positively chemotactic to juices of crushed raspberry or tomato tissue. It is living after a year in sterile soil. In saturated sterile soil it migrated at the rate of about a centimeter a day. An effort was made to locate the organism in the tissues. The evidence secured from microscopic study of the tissues at different stages of gall formation and from the development of the original and secondary galls, indicated that it was living between the cells of the host. Its intercellular position and its scarcity apparently contribute to the difficulty of demonstrating it in the tissues. Under certain conditions the organism was found to travel through the vascular bundles. This resembles a method of distribution of cancer in animals.

Studies on Plant Cancers, IV—The effect of inoculating various quantities of different dilutions of Bacterium tumefaciens into the tobacco plant. MICHAEL LEVINE.

Tobacco plants of uniform age and size and growing under uniform conditions of soil and light were inoculated with *Bacterium tumefaciens*. In these experiments I have not counted the organisms, but have used suspensions in small quantities, varying from the ordinary agar culture emulsions to dilutions equal to 1:100, to determine the effect of these varying quantities of bacteria on this host. Of 350 plants so tested, no marked difference could be detected in the size of the crown galls resulting. The inoculation of a drop of the weakest suspension of the crowngall organisms in a growing region often incited crown gall development much larger than a suspension forty times more concentrated. A comparison of the reaction of different parts of the plant to suspensions of equal dilutions was made. It was found that decapitated stems, inoculated with *Bacterium tumefaciems* into the cut end of the stem invariably produced the largest crown galls. Stems uninjured produced crown galls next in size, while the crown galls in the midveins of the leaves were smaller. A test of the relative virulence of three different ages of cultures was made. The cultures used were subcultures of *Bacterium tumefaciens* of the hop strain which had been grown on bean agar for the past three years and transferred to fresh media at intervals of about a month. It was found that cultures two days old were no more effective in producing crown galls in tobacco than were cultures seven days old and three weeks old. The sizes of the crown galls resulting from apparently equal dilutions of these cultures were approximately the same as those from unequal dilutions. It is concluded that the number of cells of *Bacterium tumefaciens* inoculated into the tobacco is not significant in determining the size of the crown galls produced. A smaller number of bacteria favorably lodged in tissue capable of response will produce a crown gall equal in size to that produced by a larger number. The size of the crown gall is rather dependent upon the region of inoculation and the vitality of the host than on the number of bacteria causing the infection.

A new peach wilt disease. C. M. HAENSELER.

During the summer of 1921 a new peach-wilt disease affecting from five to twenty per cent. of the trees was observed in several two to four-year-old orchards in Camden and Burlington counties, New Jersey. The disease started when the new growth was in its most rapid development, became most severe during a June drought, and ceased further development after August. Diseased portions of a tree show a shedding of the older leaves, wilting of the growing tips, and subsequent death of the twigs. General-

ly one or more of the main branches die, the rest of the tree remaining apparently normal. Darkening of the wood portion of all affected parts, new wood as well as one to three-year-old wood, is characteristic. This wood discoloration can generally be traced from the diseased shoot down the trunk to below the ground level, where infection apparently takes place. Microscopic examination of new and old diseased wood shows a copious fungus growth in the wood vessels. Tissue cultures from over thirty twigs taken from different orchards gave a species of Verticillium in approximately 75 per cent. of the cases. This Verticillium was compared with *V. albo-atrum* from okra and egg plant but no marked morphological or cultural differences could be noted. Inoculation experiments are in progress. A possible relation between this Verticillium wilt of peach and winter injury is suggested.

Relative susceptibility of citrus plants to Cladosporium citri Massee. GEORGE L. PELTIER AND WM. J. FREDERICH.

In connection with our citrus canker investigations in Alabama, an opportunity was afforded to note the relative susceptibility of Rutaceae plants to scab. With the exception of the trifoliate orange, all relatives tested are non-susceptible, and scab appears to be strictly limited to the citus fruits and their hybrids. The pointed leaf form of "Cabayao," mandarins, calamondin, and kanzu oranges, all resistant to canker, are susceptible to scab. Grape fruits vary in susceptibility, while all lemons are susceptible. No scab has been observed on plants of the sweet orange group. Trifoliate and citrange hybrids vary from slightly to very susceptible. The citrangequat (citrange x kumquat) is extremely susceptible to scab, although kumquat is outside the range of scab susceptibility, while the orange of the citrange cross is non-susceptible. On the other hand, this hybrid is the most promising canker-resistant plant so far found. The orangequat (sweet orange x kumquat, both non-susceptible), is quite susceptible to scab. The bigaraldin (sour orange x calamondin, both susceptible to scab) has remained non-susceptible. Judging from the results obtained, scab susceptibility is not as clear cut as that observed for canker, and appears to be influenced by the reaction of the host plant to environmental conditions essential for scab infection and subsequent development of the disease.

Weather and its relation to citrus scab epidemics in Alabama. GEORGE L. PELTIER AND WM. J. FREDERICH.

Under Alabama conditions, temperatures for optimum infection usually prevail during April and May. Sufficient moisture is generally at hand during this interval for successful infection to take place. The most important and variable factor is the development of the first spring growth. Any environmental factor or factors inducing a slight spring growth and rapid maturation favors escape of scab, while any environmental factor or factors inducing a large amount of spring growth and slow maturation favors scab susceptibility. The conditions essential for an epiphytotic are a late season, sufficient moisture, and the development of spring growth at the time optimum temperatures for infection prevail. An early season is favorable to scab escape, in that the first spring growth is about complete when optimum conditions for infection are at hand. Under Alabama conditions, a light or bad scab year can be predicted by the monthly mean temperature prevailing during March; a monthly mean temperature below normal is an indication of a bad scab year; while a normal temperature (59° F.), or above, is indicative of a light infection.

A preliminary report on the control of raspberry anthracnose. LEON K. JONES.

In 1920 and 1921 experiments on the control of raspberry anthracnose were conducted at Madison, Wisconsin. Lime-sulphur, alone and in combination with gelatin, glue, and saponin, respectively, and Bordeaux mixture, alone and in combination with gelatin, glue, milk, and caseinlime, respectively, were tested comparatively on Cumberland black raspberries. Two applications were made, 1. after the first two or three leaves had unfolded, and 2. about one week prior to the opening of any blossom buds. Each of the fungicides, alone and in combination with its various adhesives, was used in the following programs: 1. Both applications, 2. first treatment only, and 3, second treatment only. Lime-sulphur, 1–10, and Bordeaux mixture, 6–6–50, were used in the first applications, and lime-sulphur, 1–40, and Bordeaux mixture, 3–3–50, in the second. In both seasons the disease was satisfactorily controlled by spraying, lime-sulphur giving better results than Boreaux. With lime-sulphur, glue and gelatin gave the best results as adhesives; with Bordeaux mixtures, gelatin and caseinlime. The two-spray program gave satisfactory control each season. In 1921 the first application alone, with lime-sulphur and gelatin, controlled the disease satisfactorily on plants which had been well sprayed the previous year. The second application alone failed to control the disease in any case. On unsprayed plants the disease developed abundantly in both seasons.

Leaf curl and mosaic of the cultivated red raspberry. W. H. RANKIN, J. F. HOCKEY AND J. B. MCCURRY.

These diseases, previously confused under the name "yellows", are distinct and easily separable. Both diseases are systemic and cause dwarfing. In leaf curl the leaflets are very dark green, and the midrib and main lateral veins arch downward, causing a curling of the entire margin of the leaf. The tissue arches between the veins and causes a puckering along the veins. In mosaic, the leaflets on new growth in spring show large green blisters, with yellow-green tissue between. In summer and autumn the mottling is much finer and gives the leaf a uniform yellowish, speckled appearance. On fruiting canes the leaves are either coarsely or finely mottled and reach only one-half normal size. In the Niagara district of Ontario leaf curl is enphytotic in Cuthbert, affecting from five to ten per cent. of the stand. Mosaic is epiphytotic in Cuthbert and Marlboro, to the extent of an average infection of twenty to thirty per cent. Only one disseminating agent, *Aphis rubiphila*, is suspected for both diesases. Leaf curl transmission by this agent has been proved. No causal organism for either disease has been found. Control of mosaic is anticipated by roguing in August, thus preventing aphid eggs over-wintering on diseased wood. Leaf curl has been reduced by a single roguing in July for two years from 4.4 per cent. in 1919 to 1.9 per cent. in 1920 and 0.0 per cent. in 1921. Roguing for leaf curl as soon as the bushes leaf out will give commercial control. The bushes in the case of both diseases must be dug carefully to get the entire root and removed immediately to a distance to prevent the migration of the aphids to healthy bushes.

Records for four years on the needle blight of Pinus strobus. J. H. FAULL.

"Needle blight" of *Pinus strobus* has been reported by the Forest Service and by lumbermen many times from 1905 onward. Investigations were begun in 1918. The disease manifests itself as a reddening of the new needles and has been so abundant that certain pine areas have assumed an autumnal coloration in midsummer. The trouble has been variously ascribed to winter injury, late frosts, insects, fungi, etc., and has

been confused with winter browning and sulfur fumes injury. It has been discovered that it begins with a killing of the roots, apparently due to a combination of soil peculiarities and drought conditions, hence the root system is not able to supply the sudden demand for water made by the new foliage. Repeated blighting results in the death of affected trees. Hundreds of trees were examined in 1918 and tagged with serially numbered metal disks. Out of 275 healthy trees 2 have since developed blight and under exactly known conditions. Out of 147 trees 6 inches in diameter or less 7 per cent. have died. Out of 211 trees over 6 inches in diameter 23.7 per cent. have died. The results so far show that young stands for the most part recover, but that mature stands are seriously injured.

Chemical injuries to white pines. WALTER H. SNELL AND N. O. HOWARD.

During the summer of 1921 two non-parasitic troubles of the white pine came under observation. In one case in Massachusetts a lot of 25 to 30 acres of white pines, which appeared from a distance to be totally dead, were found to be still alive, but only the basal portions of the needles were living. Gases from the chimney of a brick kiln about ¼ mile north were suspected as the cause of the damage. A checking of the weather records, with the dates of burning of the kiln, substantiated the suspicions that such gases (probably SO_2) caused the trouble. Another case of the death of pine trees was along the roadside in New Hampshire. It was found that barrels of calcium chloride for application to the road had been stored under these trees and the salt which seeped into the soil had killed the pines and partially defoliated the elms and birches nearby.

Hypoxylon poplar canker. ALFRED H. W. POVAH.

This disease, caused by *Hypoxylon pruinatum* (Klotsch) Cke., has been found in Essex and Oswego Counties, New York, in Michigan and in Maine. The disease is a trunk canker which kills the bark. Often the tree is girdled, which results in the death of the whole upper part. Usually the dead top is sooner or later broken off by the wind. A survey of a sample plot in Essex County, N. Y., showed 37 per cent. of *Populus tremuloides* infected and 27 per cent. of them killed by this disease. A diagnostic feature of the disease is the blackening of the sapwood. When the bark is peeled from a canker, the discoloration shows as points, extending vertically, on which are found fans of white mycelium.

The effect of heat upon the mycelium of certain structural timber destroying fungi within wood. WALTER H. SNELL.

Spruce blocks ¾ inch in cross section thoroughly grown through with *Lenzites sepiaria, L. trabea, Trametes serialis, T. carnea,* and *Lentinus lepideus* were submitted to various degrees of heat for varying periods in wet and dry atmospheres to determine the thermal death point of the mycelium within wood. None of the fungi could survive 55° C. moist heat for 12 hours and only one (*Lenzites trabea*) withstood 3 days at 44° C. moist heat. At 60° C. dry heat, the time necessary to kill the mycelium was 5 to 12 days, varying with the species. At 90° C. only *L. trabea* could survive 24 hours, and not until 105° C. dry heat was reached would 12 hours exposure kill the mycelium of all the fungi. It is concluded that heating structures affected with decay to 47–48° C. by means of the heating systems, as has been suggested, would not kill the fungi even in moist cotton weave sheds, although the drying effect would be beneficial in certain types of structures. The application of these results to the effect of kiln drying upon structural timber decay is pointed out.

The occurrence and development of pathological resin canals in the Coniferae. ARTHUR S. RHOADS.

The writer has made an extensive study of pathological resin canal formation in a large number of the Coniferae, with regard to the various causes stimulating their development, the manner and extent of their occurrence as a result of numerous diverse types of wounding, and the pathological anatomy of such resin canal formation and its biological and phylogenetic significance. The conditions stimulating the formation of pathological resin canals may be classified as follows: 1. Injuries to the cambium resulting from all kinds of mechanical wounding, including those occasioned by animals and insects; 2. attacks by various parasitic fungi and mistletoes; and 3. abnormal physiological conditions of growth and nutrition, in which the direct influence of wounding or of attacks by parasitic plants is lacking, which produce a pathological condition of the plant. While usually of purely local extent in most mechanical injuries, pathological resin canals may form continuous rows, extending entirely around the growth ring and for many feet vertically, as often occurs in lightning injury and severe cases of sap-sucker injury. By reason of its anatomical structure, a zone of pathological resin canals constitutes a decided line of weakness. The use of small pieces of wood containing such formations should therefore be discriminated against for purposes requiring great strength, as in aeroplane parts, since they are very likely to fail under such stresses as would invite cleavage or shearing with the grain. Pathological resin canals are now known to occur in all the genera of the Abietineae and in the genus Sequoia of the Taxodineae, and occur in as many species of these genera as have been investigated in this respect. Neither their presence nor absence nor their position within any part of the growth ring can be of diagnostic value. Their formation in the conifers is parallelled by the formation of analogous structures in a number of dicotyledonous woods.

Helminthosporium heveae Petch, in Sumatra. CARL D. LA RUE.

Helminthosporium heveae was described by Petch on *Hevea brasiliensis*, the Para rubber tree, more than fifteen years ago. Bancroft in 1911 stated that there was no record of its occurrence in the Federated Malay States. Butler in 1918 says the disease occurs in Malaya, Ceylon, South India, and Java. Both Petch and Butler state that the fungus is confined to young rubber trees. This is usually true in Sumatra, but in 1919 the writer found it on old trees on numerous estates. In some cases the leaves were riddled with spots and the injury must have been very considerable. The disease does not cause defoliation of the affected trees, and where defoliation occurs it is usually found to be due to a simultaneous attack of mites. The fungus attacks the leaves and occasionally the bark of young twigs. Infection occurs just as the young leaves unfold, and the old leaves, either fallen or still hanging on the trees, are probably the source of the infecting spores. The fungus is easily grown in culture but fruits slowly. The Sumatran forms agree with Petch's description, except that the spores are rather small.

Pulp storage in water. R. J. BLAIR.

Ground wood pulp, which is manufactured by the simple processes of holding sticks of wood against a revolving grind-stone, often seriously deteriorates in storage through the action of molds and wood-destroying fungi. Invasion by such organisms is rendered easy, as the material is always stored in a moist condition. It is an accepted fact that wood immersed in water is immune to fungus attack. An experiment was carried out using several kinds of commercial pulps in order to test the preservative value of water upon sheets of pulp immersed in it. After an interval of seventeen months the pulp

was examined and tested for freeness. It was then made into small sheets of paper, which were tested for bursting strength and for tensile tear. The pulp stored in water came through the test in much better condition than that which was piled on a shed where it was given an opportunity to dry out.